

COUNTY DRAINS IN THE GALIEN RIVER WATERSHED

DRAIN NAME	TOWNSHIP	DATE OF ESTABLISHMENT	LENGTH	DATE OF MOST RECENT IMPROVEMENT	DATE OF FUTURE IMPROVEMENTS	NOT ON WATERSHED MAP	ADDITIONAL COMMENTS
Anderson & Tibbles	Weesaw	1938	2345'	-		X	
Babcock	Weesaw	1927	4372'	1996			
Blue Jay	Weesaw				next couple of years		
Blue Jay-North Branch	Weesaw	1922	15,788'	1996	next couple of years		
Bowers & Penwell	Weesaw	1903	2465'	1967			
Carpenter & Ferry	Weesaw	1906	13199'	1997			
Carpenter & Holden	Weesaw	1911	6126'	1994			
Charles Orris	Weesaw	1916	6875'	1993			
Clark & Bowers - W. Br.	Weesaw	1985	not listed	1987		X	
Clark & Bowers	Weesaw	1917	7474'	1996		X	
Clark & Bowers - E. Br.	Weesaw	1922	1300'	1984		X	
Clark & Goodell	Weesaw	1903	3720'	1997			
Close	Weesaw	1891	34,400'	1996	next couple of years		
Dempsey	Weesaw	1915	6000'	1997		X	
Dinges	Weesaw	1921	1310'	1995			
Fowler	Weesaw	1907	20,900'	1993			
Galien River	Weesaw	1890	not listed	1955			
Galien River - S. Br. Ext.	Weesaw	1930	not listed	1934			
Galien River - S. Br.	Weesaw	1908	19148'	1991	next couple of years		especially along Elm Valley
Gardner	Weesaw	1885	5222'	1993			
Garfield Ave	Weesaw	1887	8875'	1993			
Gifford	Weesaw	1906	10,482'	1993			
Gifford Ext.	Weesaw	1952	15,321'	1993			
Gifford Ext. Partial	Weesaw						
Glaske & Krieger	Weesaw	1911	2157'	1995		X	
Hall & Potter	Weesaw	1899	5443'	1996			
Hanover	Weesaw	1917	7957'	1991		X	
Hanover S. Br.	Weesaw	1917	2472'	1994		X	
Haskins #15	Weesaw	1899	3620'	1941			
Hess	Weesaw	1897	3054'	1997		X	
Hickory Cr. - Ext. & Outlet	Weesaw	1903	not listed	1961			
Hickory Creek	Weesaw	1894	43,246	1997			
Hickory Creek Partial	Weesaw	1985	not listed	-			
Hickory Creek Partial - 1994	Weesaw	1994	not listed	-			
Holden & Smith	Weesaw	1917	4800'	1997			
Holden & Smith - Partial	Weesaw	1996	not listed	1996			
John English	Weesaw	1903	6550'	1995			
Judy Lake	Weesaw	1898	26015'	2000			
Lake & Weesaw Twp Line	Weesaw	1922	3340'	1984			
Lintner, Allen & Ren Barger	Weesaw	1909	6926'	1997			
Log Cabin Road	Weesaw	1994	not listed	1997			
Ludlam	Weesaw	1917	1900'	1993		X	
Luther	Weesaw	1917	3340'	1995		X	
Mc Donald	Weesaw	1927	2116'	1996			
Miller & Ristoff	Weesaw	1952	5260'	1982			
Minnich Road	Weesaw						no card
Moore, Klassner & Hess	Weesaw	1883	2380'	1994			
Moore, Klassner & Hess - old	Weesaw	1967	not listed	1997			
Mud Hollow	Weesaw	1898	2772'	1994			
Murdock & Beeson	Weesaw	1896	5460'	1993		X	

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New Troy Village	Weesaw	1950	2484'	1993		X	
New Troy Village - Detroit St. Br.	Weesaw	1981	848'	1981		X	
Nimtz & Rantz	Weesaw	1918	4080'	1997			
Norris Lake	Weesaw	1902	17,340'	1993			
Norris Lake	Weesaw				next couple of years		
Nowlan ?	Weesaw						no card
Orris & Weaver	Weesaw	1916	5660'	1990		X	
Ott & Krieger	Weesaw						
Painter & Weatherwax	Weesaw	1901	4800'	1997			
Painter & Weatherwax-Wagner Br.	Weesaw	1996	not listed	1997			
Pardee, McDonald & Clark	Weesaw						no card
Penwell	Weesaw	1937	2310'	1996			
Pierce, Lewin & Jennings	Weesaw	1896	4892'	1996		X	
Prekert & Murdock	Weesaw	1914	7876'	1993			not found
Priebe	Weesaw	1922	1758'	1993			
Pufall	Weesaw	1928	2900'	1993			
Reese	Weesaw	1915	4600'	1993		X	
Robbins	Weesaw	1916	1710'	1996		X	
Rug Lake	Weesaw	1921	3482'	1991			
Shields	Weesaw	1898	4020'	1995			
Smith & Nowlen	Weesaw	1885	10,724'	1996			
Sober & Becker	Weesaw	1906	21,900'	1993			
Sober & Becker Ext.	Weesaw	1937	4930'	1987			
Sober & Becker So. Br.	Weesaw	1931	9220'	1985			
Sober & Becker So. Br. Partial	Weesaw						
Stevens	Weesaw	1916	1650'	1992		X	
Troy	Weesaw	1901	1454'	1993			
Troy Meadow	Weesaw	1897	8267'	1994			
Troy Meadow Outlet	Weesaw	1935	6760'	1995			
Washburn	Weesaw	1917	1828	1996			
Weaver & Haroff	Weesaw	1913	22,675'	1995			
William Morley	Weesaw	1918	3035'	1945		X	
Williams & Essig	Weesaw	1910	2400'	1994			
Wolf Creek	Weesaw	1934	10,626	1993			
Bethany Beach	Chikaming						not in watershed
Close	Chikaming				next couple of years		
Edinger	Chikaming						not in watershed
Gifford	Chikaming	1906	10,482'	1993			
Gifford Ext.	Chikaming	1953	15,321' total	1993			
Gifford Ext. Partial	Chikaming	1980	-	-			
Hellinga	Chikaming	1914	15,032'	1993			
Indian Trails Estates	Chikaming	1976	2832'	1977			
John Morley Br.	Chikaming	1925	2550'	1941			
Minnich Road	Chikaming						no card
Streed	Chikaming	1931	8828'	1986			
Streed Ext.	Chikaming	1938	7346'	1981			
Streed Relief	Chikaming	1961	1370'	1986			
Union Pier	Chikaming	1909	6871'	1995	next couple of years		
Bain	Lake	1898	1115'	1978			
Barfelz	Lake	1928	2150'	1993			

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Becker	Lake	1885	12292'	1983			
Becker N. Br.	Lake	1983	not listed	1983			
Becker S. Br.	Lake						no card
Clark & Duart	Lake	1898	6303'	1994			
Clark & Duart Ext.	Lake	1936	2472'	1980			
Galien River	Lake	1890	not listed	1951	next couple of years		
Gaul	Lake	1890	4366'	1994			
Grande Mere Lake	Lake	1931	not listed	1997			
Hauser & Hendrix W. Ext	Lake						no card
Hauser & Hendrix	Lake	1903	not listed	1997			
Hickory Creek Ext.	Lake	1903	not listed	1961			
Hickory Creek	Lake	1894	43246'	1997			
Hickory Creek Partial	Lake	1985	-	-			
Hickory Crrek Partial 1994	Lake	1994	-	-			
James	Lake	1914	7060'	1997			
James Partial	Lake						no card
Johns	Lake	1899	14834'	1995			
Kill	Lake	1908	9635'				
Kill Bowling Green	Lake	1996	not listed	1997			
Kill Clark & Duart Contribution	Lake	1996	not listed	1996			
Kill East Br.	Lake	1996	not listed	1997			
Kill Partial A	Lake	1983	-	-			
Kill Partial B	Lake	1983	-	-			
Livengood	Lake						
McDaneld	Lake	1927	2116'	1996			
Merklin	Lake	1965	707.5'	1990			
Miller & Ristoff	Lake	1952	5260'	1982			
Nazke & Smikel	Lake	1917	1000'	1993			
Price	Lake						
Smith & Nowlan	Lake	1885	10,724'	1996			
Smith & Nowlan Ext.	Lake	1955	1678'	1993			
Smith & Nowlan Partial	Lake	1976					
Sober & Becker	Lake	1906	2190'	1993			
Sober & Becker Ext.	Lake	1937	4930'	1987			
Sober & Becker So. Br. Partial	Lake						project failed
Sober & Becker So. Br.	Lake	1931	9220'	1985			
Woodridge Estates	Lake						no card
Johns	Baroda	1899	14,834'	1995			
Nixon & Landon	Baroda	1917	2508'	1974			
Schutze & Br.	Baroda	1919	2285'	1993			
Sober & Becker	Baroda	1906	31,120'	1993			
Chaimberland & Ext.	Three Oaks	1887	29,097'	1993			
Chestnut	Three Oaks	1977	3040'	1977			
Close	Three Oaks	1891	34,400'	1996	next couple of years		
Close Partial A & B	Three Oaks						1936 deemed unnecessary
Deer Creek Br.	Three Oaks	1934	1238'	1995			
Deer Creek Br. Partial	Three Oaks	1980	2224'	1995			
Forest Lawn	Three Oaks	1992	1030'				maintained by Forest Lawn Land Fill
Gale Wilson	Three Oaks	1954	not listed	1982			
Galien River	Three Oaks	1890	not listed	1951			

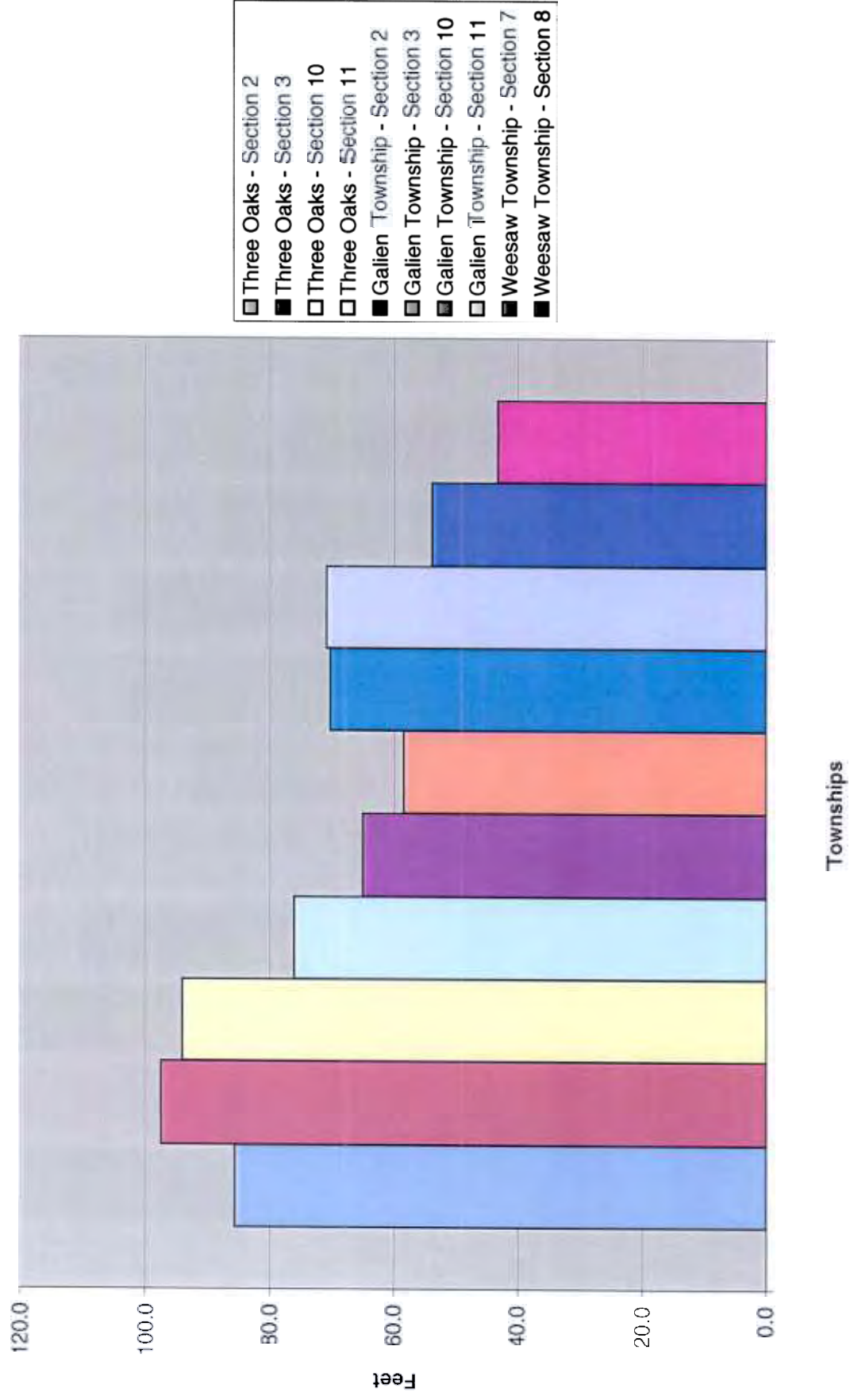
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Gifford	Three Oaks	1906	10482'	1993			
Gifford Ext.	Three Oaks	1953	15321' total	1993			
Hellenga	Three Oaks	1914	15032'	1993			
Payne & Donner	Three Oaks	1928	5331'	1993			
Schwark	Three Oaks	1972	2816'	1993			no card
Wild Rose	Three Oaks	1908	21,667'	1995	next couple of years		
Baker Town	Buchanan	1894	19,014'	1995			
Blue Jay	Buchanan	1902	21,180'	1990	next couple of years		
Cassler	Buchanan	1908	4633'	1990			
Chippewa - Walnut	Buchanan						no card
Clear Lake	Buchanan	1997	not listed	1997			not in watershed
Close	Buchanan	1891	34,400'	1996	next couple of years		
Coveney Lake	Buchanan	1918	4300'	1993			
Cresent View	Buchanan						not in watershed
Cresent View South	Buchanan						not in watershed
Fuller & Nutt	Buchanan						outside watershed
Galien River	Buchanan	1890	not listed	1951			
Galien River South Br. Ext.	Buchanan	1930	not listed	1934			
Galien River South Br.	Buchanan	1908	19,148'	1991	next couple of years		
Gray's Run South Br.	Buchanan						outside watershed
Haskins #15	Buchanan	1899	3620'	1941			
Hickory Creek Ext. Outlet	Buchanan	1903	not listed	1961			
Hickory Creek	Buchanan	1894	43,246'	1997			
Hickory Creek Partial	Buchanan	1985	not listed	-			
Hickory Creek 1994	Buchanan	1994	not listed				
Judy Lake	Buchanan	1898	26,015'	2000			
Lake & Creek	Buchanan						outside watershed
Lutz	Buchanan	1947	2330'	1947			
Madron Lake #4 or North Branch	Buchanan	1898	6204'	1990			
Madron Lake South	Buchanan	1904	10,183	1997			
Madron Lake #2 Full District	Buchanan	1934	4633'	1995			
Mutchler & Sabin	Buchanan	1898	1848'	1898			
Powers & Miller	Buchanan	1961	6000'	1993			
Snedker	Buchanan	1921	2384'	1956			
Spaulding	Buchanan	1909	6389'	1990			
Spaulding Partial	Buchanan	1971	not listed	1990			
Wagner Lake	Buchanan	1899	15,378'	1899			
Weaver & Harroff	Buchanan	1913	22,675'	1995			
Weaver & Harroff - Partial	Buchanan	1976	not listed	1995			
Wilson & Marble	Buchanan	1938	13,854'	1993			
Blakeslee & Glover	Galien						not cty drain 3/4/88
Chamberlain & Ext.	Galien	1887	29,097' total	1993			
Clark & Swark	Galien	1918	5000'	1996			
Close	Galien	1891	34,400'	1996	next couple of years		
Close Part A	Galien						deemed not necessary
Close Part B	Galien						deemed not necessary
Critchett, Allen & Huston	Galien	1903	not listed	1996			
Cuthbert & Imhoff	Galien	1909	8786'	1993			
Dayton Lake	Galien	prior to 1958	not listed				
Denison & Roundy	Galien						not cty drain 11/15/88

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Dowling Creek	Galien	1950	2970'	1994			
Galien River	Galien	1890	not listed	1951			
Galien River South Br.	Galien	1908	19,148'	1991	next couple of years		
Galien River South Br. Ext.	Galien	1930	not listed	1934			
Galien Village	Galien	1918	3960	1993			
Geminder & Ext.	Galien	1909	6490	1997			
Geminder Ext. & Partial	Galien	1939	1510'	1992			
Hall & Potter	Galien	1899	5443'	1996			
Horine, Thompson & Jerue	Galien						not cty drain 3/4/88
James & Grooms	Galien	1925	12,919	1993			
J S Ingles	Galien						not cty drain 11/3/88
Jerue & Goodenough	Galien	1914	3883	1997			
Lintner, Allen & Renbarger	Galien	1909	6926'	1997			
Luther & Doehrer	Galien	1921	2690'	1995			
Moore, Klassner & Hess	Galien	1929	2380'	1994			
Moore, Klassner & Hess East Br.	Galien	1919	not listed	1994			
Moore, Klassner & Hess Old	Galien	1967	not listed	1997			
Partridge & Heimert	Galien	1913	2950'	1993			
Storm & Cowell	Galien	1903	4255'	1993			
Storms	Galien	1918	2860'	1994			
Toland, Bryant & Davidson	Galien	1933	3828	1996			
Wild Rose	Galien	1908	21,667'	1995	next couple of years		
Wilson & Marble	Galien	1938	13,854'	1993			
Wolf, Artus & Heimert	Galien	1906	1882'	1994			
Zaring & Russ	Galien	1908	15,040'	1993			
Zaring & Russ Ext.	Galien	1994	not listed	1994			
Mud Hollow	Bertrand	1898	2772'	1994			
Close	Bertrand				next couple of years		
Galien South Branch	Bertrand				next couple of years		
Blood Run	New Buffalo	1883	11,823'	1997			
Lake Shore	New Buffalo	1885	5724'	1996			
Squaw Creek	New Buffalo	1883	4950'	1993			
Squaw Creek Holiday Dr. Ext.	New Buffalo						no card
State Line	New Buffalo						not a county drain
Timber Lane	New Buffalo	1995	not listed	1995			
Union Pier	New Buffalo	1909	6871'	1995	next couple of years		

Average Depths of Wells



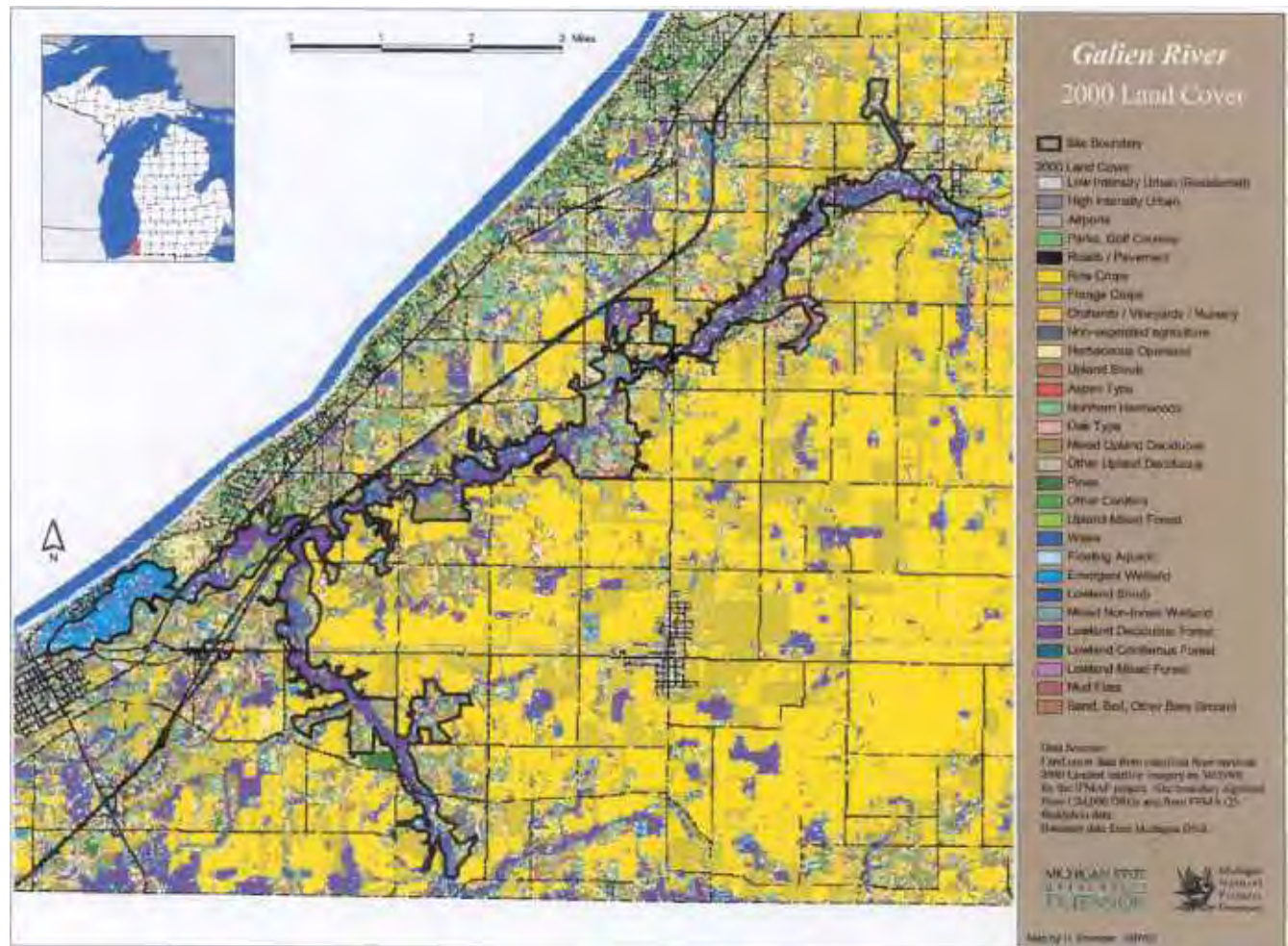
Site Ecological Summary

Site Name: Galien River
County (s): Berrien
Size: 3800 acres, 6 mi²
Great Lakes shoreline: 0 miles
Rivers/streams: 68 miles

Ecological Boundaries:

This site encompasses the most intact portions of forested floodplain and adjacent upland tracts along the main and south branches of the Galien River and includes the Great Lakes marsh associated with the river mouth.

Figure 1. 2000 Land Cover

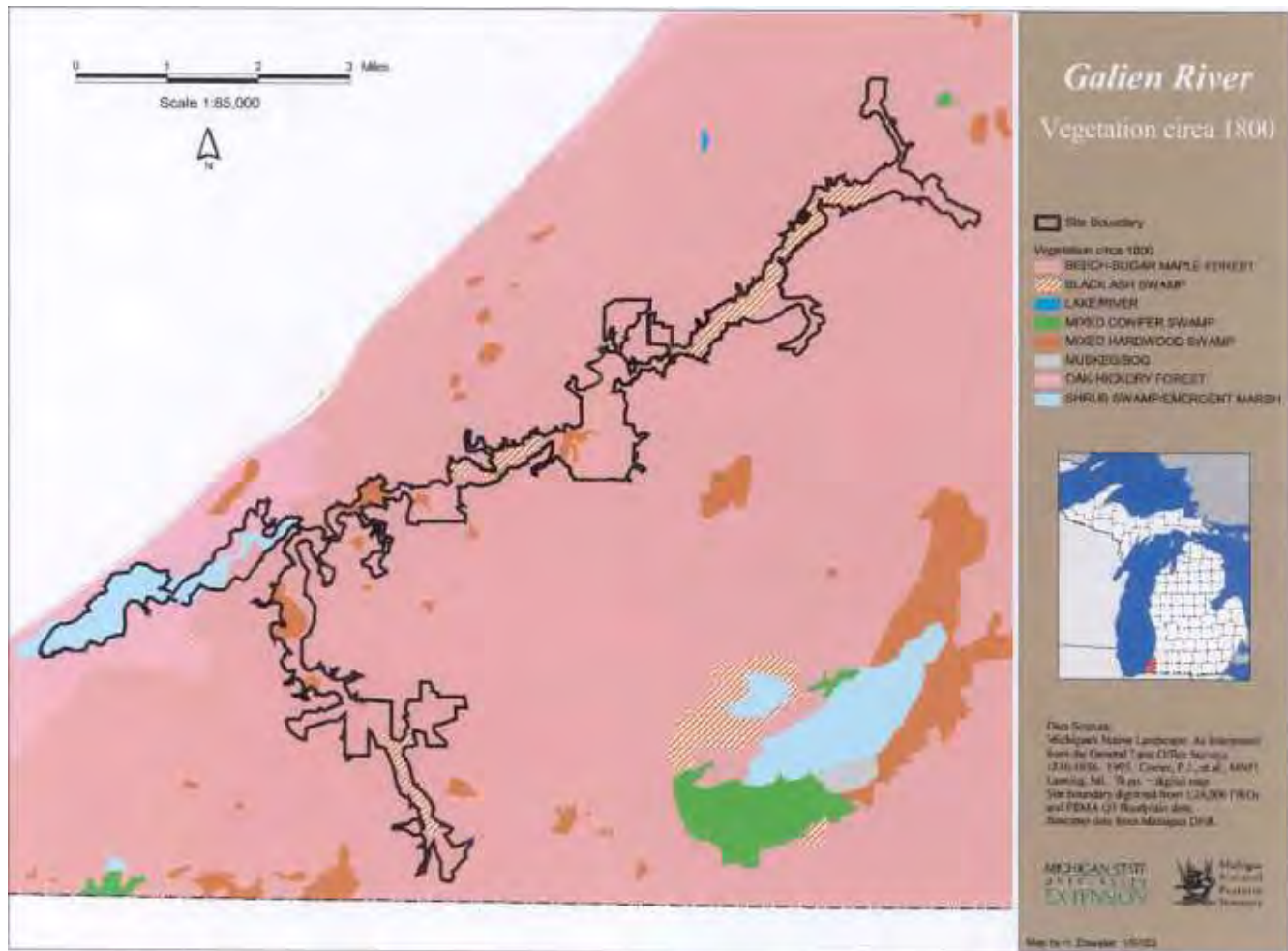


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Landscape Context:

The site is located in the southern Michigan lake plain and consists primarily of lacustrine deposits with some fine textured end and ground moraines. The topography of the area is flat to gently rolling. Most surface lacustrine deposits are sand while those of the moraines are loams or clays. In the 1800's forests in this area were dominated by beech and sugar maple with white oak and black oak common along the bluffs and broad ridges above the Galien River. Lowland hardwoods dominated by black ash and silver maple and extensive marshes formed broad bands along the river. Local references by surveyors indicate that Native Americans used fire to manage the land along the Galien river. Presently most of the lands are in agriculture and the wooded corridor along the river represents what remains of the old growth forest (Albert 1994).

Figure 2. Circa 1800 Vegetation



General Site Description:

The site is located in the southwestern most portion of the lower peninsula along the Galien River, just north of the Michigan-Indiana border and just east of Lake Michigan. The majority of the site is privately owned except for the Warren Woods Natural Area, a dedicated natural area owned by the state of Michigan. Most of the site is characterized as mesic southern forest and southern floodplain forest with associated ravines, found along the main and south branches of the Galien River. Warren Woods Natural Area contains a tract of old-growth beech-maple forest and floodplain forest. Near the mouth of the Galien River there is an area consisting of emergent marsh and wet meadow that is considered a quality Great Lakes marsh community. This marsh is essentially a drowned river mouth and contains extensive, fertile wetland habitat.



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Figure 3. Element Data Tables

State Natural Areas	Acres
Warren Woods Natural Area	
Total Acres	

Quality Natural Communities	# of EO's
Great Lakes marsh	1
Mesic Southern forest	1
Southern floodplain forest	1

Most Common Elements	# of EO's
Prairie trillium	4
Yellow-throated warbler	3
Blanchard's cricket frog	2
Cup-plant	2

Elements	Types	# of EO's
Communities	3	3
Animals	10	13
Plants	11	15
Total	24	31

Figure 4. Element Occurrence Table

Galien River

EOCODE	SCIENTIFIC NAME	US	MI	LASTOBS	GRANK	SRANK	EO RANK
CPV0000000*043*MI	GREAT LAKES MARSH			1988-07-26	G2	S2	B
AFCAA01020*001*MI	ACIPENSER FULVESCENS		T	1970	G3	S2	
CPH0000000*001*MI	SOUTHERN FLOODPLAIN FOREST			1981-09-05	G3?	S3	AB
CTA0000000*001*MI	MESIC SOUTHERN FOREST			1987	G3?	S3	A
ABPBX03130*001*MI	DENDROICA DOMINICA		T	2001-07-26	G5	S1	E
ARAAD04010*001*MI	EMYDOIDEA BLANDINGII		SC	1990-05	G4	S3	E
ABNKC19030*062*MI	BUTEO LINEATUS		T	1991-06-27	G5	S3S4	B
PMLIL200R0*007*MI	TRILLIUM RECURVATUM		T	1996-05-02	G5	S2S3	A
PDAST8L0A0*003*MI	SILPHIUM PERFOLIATUM		T	1993	G5	S2	B
PMLIL200R0*029*MI	TRILLIUM RECURVATUM		T	1996-06-11	G5	S2S3	A
PMCYP033G0*001*MI	CAREX DAVISII		SC	1932-05-27	G4	S3	
AAABC01011*100*MI	ACRIS CREPITANS BLANCHARDI		SC	1997-04-29	G5T5	S2S3	E
ABPBX07010*003*MI	PROTONOTARIA CITREA		SC	1997-05-13	G5	S3	E
IMGASJ9040*001*MI	POMATIOPSIS CININNATIENSIS		SC	1955	G4	SU	
PDMOR0D040*017*MI	MORUS RUBRA		T	1921-05-19	G5	S2	
PDAST8L0A0*002*MI	SILPHIUM PERFOLIATUM		T	1981-08-07	G5	S2	D
PMPOA23010*003*MI	DIARRHENA AMERICANA		T	1981-09-05	G4?	S2	C
ABPBX03130*005*MI	DENDROICA DOMINICA		T	1997-05-13	G5	S1	E
AAABC01011*096*MI	ACRIS CREPITANS BLANCHARDI		SC	1997-04-29	G5T5	S2S3	E
PDMA0H0R0*002*MI	HIBISCUS MOSCHEUTOS		SC		G5	S3S4	
PDVIO02020*017*MI	HYBANTHUS CONCOLOR		SC		G5	S3	
PMLIL200R0*034*MI	TRILLIUM RECURVATUM		T	1995-05-12	G5	S2S3	C
PMPOA1D010*001*MI	CHASMANTHIUM LATIFOLIUM		T	1981-10-05	G5	S1	C
PMLIL200R0*003*MI	TRILLIUM RECURVATUM		T	1980-05-03	G5	S2S3	A
AMAFF11140*008*MI	MICROTUS OCHROGASTER		E	1919-08	G5	S1	H
PDVAL04030*001*MI	VALERIANELLA CHENOPODIIFOLIA		T		G5	S1	C
PMCYP033B0*001*MI	CAREX CRUS-CORVI		T	1952-06-28	G5	SH	
AMAFF11150*001*MI	MICROTUS PINETORUM		SC	1978-04-27	G5	S3S4	H
I1I0D001010*002*MI	TACHOPTERYX THOREYI		SC	1919-06-20	G4	S1S3	H
ABPBX03130*006*MI	DENDROICA DOMINICA		T	1997-05-14	G5	S1	E
PDAST3POM0*002*MI	EUPATORIUM FISTULOSUM		T	1991-08-28	G5?	S1	

LE=Listed endangered under the Federal Endangered Species Act

LT=Listed threatened under the Federal Endangered Species Act

C=Species being considered for federal status

E=endangered

T=threatened

SC=special concern



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Ecological Significance:

This site contains high quality examples of mesic southern forest, southern floodplain forest and Great Lakes marsh. Four animal species and eight plant species listed as state threatened or endangered have been found at this site. One area of this site that is particularly significant is the Warren Woods Natural Area. It includes 312 acres and contains a 79-acre tract of old growth beech-maple forest and floodplain forest that has not been cut during the past 110 years. Selective cutting in this tract only occurred on the south side of the river between 1882-1892 and accounted for no more than 10% of the forest. In an area of the state that has been largely cleared for farming this old growth forest is especially significant. Warren Woods Natural Area is considered unique for the outstanding degree of biodiversity that it contains. A floristic quality assessment (designed to evaluate the relative significance of tracts of land in terms of their native floristic composition) was conducted for Warren Woods. This area registered a very high floristic quality index (FQI) of 84.4 (MDNR 2001). Areas of the state with FQI scores in the 50's or higher are extremely rare and represent a significant component of Michigan's native biodiversity and natural landscapes (Herman et al. 2001). In 1925, Warren Woods Natural area contained 311 native plant species, which represents 1/6th of the state total. It contained 173 species of forbs and 36 species of native trees (MDNR 2001). Warren Woods was designated a Natural National Landmark by the Secretary of the Interior in 1967. This is a cooperative agreement between the National Parks service and the public or private landowner on whose property the area occurs. This designation means that this is a nationally significant natural area that is considered to be one of the best examples of a type of biotic community or geologic feature in its physiographic province. In 1975 the State of Michigan provided this area with the strongest form of state protection by completing a legal dedication process to dedicate Warren Woods as a natural area. Today, this area is also considered to be one of the best bird watching spots in the state, especially for warblers.

The forested corridor of the Galien River hosts three of seven known populations of the state-threatened yellow-throated warbler (*Dendroica dominica*) in Michigan. The sycamore (*Platanus occidentalis* L.) trees that occur in this riparian habitat grow above the closed canopy of the other trees. Nests are typically placed in the highest branches of sycamores at least seventy feet from the ground. Maintenance and restoration of floodplain forest that contain mature sycamore trees is critical for the conservation of the yellow-throated warbler (Evers 1991). The state special concern prothonotary warbler (*Protonotaria citria*) is also known from this site. It is a cavity nester and utilizes the forested floodplains along the banks of Galien river. The cerulean warbler (*Dendroica cerulea*), hooded warbler (*Wilsonia citrina*) and Louisiana waterthrush (*Seiurus motacilla*) all state special concern species, are also known to breed in this area, although not currently documented in MNFI's database (Adams 1991, Brewer 1991, Hull 1991 and Walkinshaw 1991). Recent studies highlight the importance of floodplain forests to many bird species that either show a clear preference or depend on these forests when compared with upland forests. Studies of nesting success for some bird species indicate that reproductive success may be higher in the floodplains than in uplands. Loss, degradation and fragmentation of floodplain forests pose a serious threat to these birds. Conservation efforts that focus on restoring degraded floodplains, maintaining high tree species diversity and wide riparian corridors will aid in their recovery. Large contiguous tracts of floodplain and adjoining upland forests are needed to reduce cowbird parasitism and provide high quality habitat for area-sensitive neotropical migratory birds (Knutson et al. 1996).

Warren Woods Natural Area contains the only population of wild-oats (*Chasmanthium latifolium*) in the state. Michigan is at the northernmost edge of the range for this state-threatened plant, which is found in southern floodplain forest habitats. This plant was first discovered in Warren Woods in the 1930's and was last observed here in 1981. Since this species is restricted to floodplains, any alterations of river hydrology could threaten its existence. Heavy foot traffic on the south and east sides of the river in the floodplain should also be avoided. Further surveys are needed to confirm that this plant is still present at this location. Warren Woods Natural area also contains one of six recently confirmed populations of the state-threatened beak grass (*Diarrhena americana*) in Michigan. In Warren Woods it occurs under a beech-maple overstory in association with rattlesnake fern (*Botrychium virginianum*), wild ginger (*Asarum canadense*), sharp-lobed hepatica (*Hepatica acutiloba*) and downy yellow violet (*Viola pubescens*). One of only three known locations of the state-threatened hollow-stemmed joe-pye-weed (*Eupatorium fistulosum*) occurs at the edge of the forested floodplain of the Galien River near Union Pier. This species is generally a more southern and eastern species and Michigan is at the edge of its range. This plant occurs in openings in lowland woods behind the dunes. This site also contains four populations of the state threatened prairie trillium (*Trillium recurvatum*), three of which are A- ranked sites. This plant occurs in floodplain forests and in rich mesic forests. Prudent management of these species dictates maintaining natural floodplain hydrology and the forest overstory.



Figure 5. Element Rank Table

Galien River

Scientific Name	Common Name	Site Count	Site A Rank	State Total	State A Rank	Sub-Sub section Total	Sub-Sub section A Rank
ACIPENSER FULVESCENS	LAKE STURGEON	1	0	33	0	3	0
ACRIS CREPITANS BLANCHARDI	BLANCHARD'S CRICKET FROG	2	0	126	5	10	0
BUTEO LINEATUS	RED-SHOULDERED HAWK	1	0	274	6	7	0
CAREX CRUS-CORVI	RAVEN'S-FOOT SEDGE	1	0	3	0	1	0
CAREX DAVISII	DAVIS'S SEDGE	1	0	12	0	1	0
CHASMANTHIUM LATIFOLIUM		1	0	1	0	1	0
DENDROICA DOMINICA	YELLOW-THROATED WARBLER	3	0	7	0	4	0
DIARRHENA AMERICANA	BEAK GRASS	1	0	11	2	1	0
EMYDOIDEA BLANDINGII	BLANDING'S TURTLE	1	0	133	0	7	0
EUPATORIUM FISTULOSUM	HOLLOW-STEMMED JOE-PYE-WEED	1	0	3	0	3	0
GREAT LAKES MARSH	NONE	1	0	77	28	9	3
HIBISCUS MOSCHEUTOS	SWAMP ROSE-MALLOW	1	0	24	1	10	0
HYBANTHUS CONCOLOR	GREEN VIOLET	1	0	18	1	1	0
MESIC SOUTHERN FOREST	RICH FOREST, CENTRAL MIDWEST TYPE	1	1	44	6	7	1
MICROTUS OCHROGASTER	PRAIRIE VOLE	1	0	9	0	3	0
MICROTUS PINETORUM		1	0	23	0	4	0
MORUS RUBRA		1	0	14	0	1	0
POMATIOPSIS CININNATIENSIS		1	0	22	0	1	0
PROTONOTARIA CITREA	PROTHONOTARY WARBLER	1	0	5	0	1	0
SILPHIUM PERFOLIATUM	CUP-PLANT	2	0	19	0	2	0
SOUTHERN FLOODPLAIN FOREST	NONE	1	1	26	3	1	1
TACHOPTERYX THOREYI	GREY PETALTAIL	1	0	2	0	1	0
TRILLIUM RECURVATUM	PRAIRIE TRILLIUM	4	3	33	4	9	3
VALERIANELLA CHENOPODIIFOLIA	GOOSEFOOT CORN-SALAD	1	0	6	0	1	0

Conservation Planning:

Based on the information provided in this document, MNFI believes that there is enough information about this site to conduct conservation planning. Furthermore, MNFI recommends that the primary conservation targets should include the southern floodplain forest community and neotropical migratory birds.

Currently 34 listed plants and 43 listed animals are associated with southern floodplain forests in Michigan. Targeting and protecting this community and the ecological processes that sustain it will help to protect the unique biodiversity found at this site such as the three A-ranked populations of prairie trillium.



Information Gaps:

Some ecological and botanical surveys were conducted by MNFI in 1995, but they were not comprehensive and only targeted high priority areas along the Galien where landowner permission was granted. Although the state threatened prairie trillium was reconfirmed at four locations, it is likely that many more populations of this plant occur at this site. Other plants, which have the potential to occur here, include: the state threatened log fern (*Dryopteris celsa*), ginseng (*Panax quinquefolius*), state threatened Jacob's ladder (*Polemonium reptans*), state special concern Kentucky coffee-tree (*Gymnocarpium dioicus*), state special concern twinleaf (*Jeffersonia diphylla*) and state threatened wild hyacinth (*Camassia scilloides*). A new comprehensive floristic inventory of Warren Woods should be completed as the last one was conducted in 1925 and may not be completely representative of the current flora at Warren Woods. It would be very instructive to compare a newly calculated FQI from the present with the one calculated from 1925 information to learn how the area has changed. It would be especially useful to gauge the impact that invasive plants have had on the flora of Warren Woods.

Periodic breeding bird censuses, by canoe and foot, should be conducted along the Galien River to better document and assess nesting habitat for neotropical migratory birds, especially the cerulean warbler, hooded warbler, Louisiana waterthrush, prothonotary warbler, and yellow-throated warbler. In addition, spring bird counts should be conducted to determine the importance of the Galien River forested corridor as stopover habitat for migratory birds. The importance of stopover habitat to migratory birds that travel great distances between their wintering and breeding grounds has only recently been addressed (Moore and Simons 1992, Moore et al. 1993). Migration is one of the most energy demanding processes in a bird's life, resulting in a weight loss of approximately one-percent per hour of flight (Alerstam 1990). The risks that migratory birds face in seeking to replenish their energy reserves while avoiding predators and adverse weather in unfamiliar habitats have been well-documented (Lindstrom 1989, 1990, Aborn 1993, Wiedenfield and Wiedenfield 1995). Since birds spend as much as half of the year or more en route between breeding grounds and wintering areas, the habitats they depend on during this period are critical links in their survival. Degradation or elimination of suitable stopover habitats has the potential to increase mortality, reduce reproductive potential, and contribute to overall population declines of migratory birds. The forested corridor along the Galien River likely provides birds a source of food (especially aquatic insects) and protection as they travel north towards their breeding grounds.

Given the landscape context, in which the forested riparian corridor of the Galien River occurs, it is apparent that this site provides critical stopover and breeding habitat for neotropical migratory birds. This site is located along an important migratory bird flight path and provides birds with an unfragmented forested corridor in a county which is dominated by agriculture and suburban development. Protecting habitat for neotropical migratory birds in this area of the state is important for maintaining this established migration route as well as intact breeding bird habitat.

Although there is one record for the state threatened red-shouldered hawk (*Buteo lineatus*) along the south branch of the Galien, further surveys are needed, especially at Warren Woods and other areas with mature forest to document the extent and productivity of this population. Systematic red-shouldered hawk surveys using conspecific taped calls should be conducted in the early spring to locate nests followed by nest checks to assess productivity in late spring and early summer. Surveys for the state special concern cooper's hawk (*Accipiter cooperii*) could be conducted in conjunction with red-shouldered hawk productivity surveys. There also is some potential for the state endangered long-eared owl (*Asio otus*) to occur at this site. Surveys using conspecific taped calls should be conducted in February when the birds are nesting. Surveys for marsh nesting birds should be conducted in the Great Lakes marsh community at the Galien River estuary. In particular there is potential for the state special concern American bittern (*Botaurus lentiginosus*), state special concern black tern (*Chlidonias niger*) and the state threatened least bittern (*Ixobrychus exilis*).

Systematic herpetological surveys have not been conducted at this site and should be initiated to reconfirm old occurrence records and document the presence of other amphibians and reptiles. Frog call surveys should be conducted in the late spring to reconfirm the two records for the Blanchard's cricket frog (*Acris crepitans blanchardi*) and to determine if there are other populations, which occur at this site. Surveys for turtles and snakes should be conducted as there is potential for additional Blanding's turtle (*Emydoidea blandingii*) occurrences as well as the state endangered copperbelly watersnake (*Nerodia erythrogaster neglecta*) which is found in buttonbush swamps. The state special concern six-banded longhorn beetle (*Dryobius sexnotatus*) has potential to occur at this site in the mature upland and floodplain forest as it is found under the bark of dead standing trees in areas that are not subject to severe flood events.



Aquatic biological data is fairly incomplete for the Galien River. Focused clam inventories, including both wading and diving surveys, are especially needed to document the distribution of rare clams and assess the habitat suitability for a number of clam species. No recent systematic clam surveys have been conducted in the Galien River to our knowledge and it would be prudent to conduct this type of an inventory. Clam species that have some probability of occurring in the Galien include: the state endangered snuffbox (*Epioblasma triquetra*) and four special concern species including; elktoe (*Alasmidonta marginata*), purple wartyback (*Cyclonaias tuberculata*) round pigtoe (*Pluerobema coccineum*) and slippershell mussel (*Alasmidonta viridis*). In addition, the black sandshell (*Ligumia recta*) which is currently not listed but is thought to be rare has the potential to occur here. All of these species are indicators of high quality river systems and clean water and are vulnerable to stochastic events, which could eliminate their populations. The state threatened lake sturgeon (*Accipenser fulvescens*) is thought to have a low probability of rehabilitation in the Galien River due to few fish being recorded recently (Whalen 2001). Fish surveys are needed though to document the occurrence of other rare fish species and to assess the habitat quality for rare fish. Two species that have some probability of occurring here include the state special concern river redhorse (*Moxostoma carinatum*) and the greater redhorse (*Moxostoma valenciennesi*) which is not listed but is considered to be uncommon to rare. Aquatic insects that have the potential to occur at this site include dragonflies in the *Gomphidae* family. Six species of dragonflies in the genus *Gomphus* and *Stylurus* are listed as state special concern. They occur in areas of rivers and streams with sandy bottoms and are good indicators of clean streams with intact headwaters. Surveys should be conducted to determine if the state special concern Grey petaltail (*Tachopteryx thoreyi*), last observed in 1919, still occurs at this site. The larvae of this dragonfly can be found in the small seeps that feed into streams and rivers. The Douglas stenelmis riffle beetle (*Stenelmis douglasensis*) a special concern species, has potential to occur at this site as it is thought to occur under the roots of trees at the edge of stream banks and under submerged wood in lakes and warm, sand bottom streams that empty into larger rivers.

Great Lakes Marsh: Potential Elements- Galien River

Scientific Name	Common Name	MI Status	US Status
Plants			
<i>Nelumbo lutea</i>	American lotus	ST	
* <i>Hibiscus moschueutos</i>	Swamp rose-mallow	SC	
<i>Zizania aquatica</i> var. <i>aquatica</i>	Wild rice	ST	
Birds:			
<i>Botaurus lentiginosus</i>	American bittern	SC	
<i>Chidonias niger</i>	Black tern	SC	
<i>Nycticorax nycticorax</i>	Black-crowned night heron	SC	
<i>Gallinula chloropus</i>	Common moorhen	SC	
<i>Ixobrychus exilis</i>	Least bittern	ST	
<i>Cistothorus palustris</i>	Marsh wren	SC	
<i>Circus cyaneus</i>	Northern harrier	SC	
Herps:			
<i>Emydoidea blandingii</i>	Blanding's turtle	SC	

* reported from site

E= endangered, T= threatened, SC=state special concern

LE= Listed endangered under the Federal Endangered Species Act

LT= Listed threatened under the Federal Endangered Species Act



Southern Floodplain Forest: Potential Elements- Galien River

Scientific Name	Common Name	MI Status	US Status
Plants:			
<i>Arabis perstellata</i> var. <i>shortii</i>	Rock cress	T	
<i>Aristolochia serpentaria</i>	Virginia snakeroot	T	
<i>Armoracia aquatica</i>	Lake cress	T	
<i>Aster furcatus</i>	Forked aster	T	
<i>Camassia scilloides</i>	Wild-hyacinth	T	
		SC	
**Carex crus-corvi	Raven's foot sedge	T	
**Carex davisii	Davis's sedge	SC	
<i>Carex frankii</i>	Frank's sedge	SC	
<i>Carex lupuliformis</i>		T	
<i>Carex seorsa</i>		T	
*Carex squarrosa		SC	
<i>Carex straminea</i>		E	
<i>Carex trichocarpa</i>		SC	
<i>Carex typhina</i>		T	
<i>Chasmanthium latifolium</i>		T	
<i>Chelone obliqua</i>		E	
<i>Corydalis flavula</i>		T	
<i>Diarrhena americana</i>		T	
<i>Dryopteris celsa</i>	Log fern	T	
*Eupatorium fistulosum	Hollow-stemmed joe-pye-weed	T	
<i>Euonymus atropurpurea</i>	Wahoo	SC	
<i>Fraxinus profunda</i>		T	
<i>Gentianella quinquefolia</i>		T	
<i>Gymnocladus dioicus</i>		SC	
<i>Hybanthus concolor</i>		SC	
<i>Isotria medeoloides</i>	Smaller whorled pogonia	E	LT
<i>Justicia americana</i>	Water willow	T	
<i>Lycopus virginicus</i>	Virginia water-horehound	T	
		T	
		T	
		E	
		T	
		T	
		T	
<i>Silphium perfoliatum</i>	Cup plant	T	
<i>Trillium nivale</i>	Snow trillium	T	
*Trillium recurvatum	Prairie trillium	T	
**Valerianella chenopodiifolia	Goosefoot corn-salad	T	
<i>Valerianella umbilicata</i>	Corn-salad	T	
<i>Viburnum prunifolium</i>		SC	

* reported from site

**Historical occurrence (>20 years old)

E= endangered, T= threatened, SC=state special concern

LE= Listed endangered under the Federal Endangered Species Act

LT= Listed threatened under the Federal Endangered Species Act

C = Species being considered for federal status



Southern Floodplain Forest: Potential Elements-Galien River Cont.

Scientific Name	Common Name	MI Status	US Status
Birds:			
*Buteo lineatus	Red shouldered hawk	T	
		SC	
		E	
		SC	
		SC	
		SC	
Fish:			
Ammocrypta pellucida	Eastern sand darter	T	
		E	
		SC	
		T	
		E	
		E	
Herps:			
*Acris crepitans Blanchardii	Blanchard's cricket frog	SC	
*Clemmys guttata	spotted turtle	T	
Clonophis kirtlandii	Kirtland's snake	E	
*Emydoidea blandingii		SC	
Sistrurus c. catenatus		SC	C
Terrapene c. carolina		SC	
Insects:			
Dryobius sexnotatus	Six-banded longhorn beetle	SC	
		SC	
		SC	
		SC	
		SC	
		SC	
		SC	
		SC	
Stylurus palgiatus	Russet-tipped clubtail	SC	
**Tachopteryx thoreyi	Grey petaltail	SC	
Mammals:			
Myotis sodalis	Indiana bat	E	LE
Mussels:			
Alasmidonta marginata	Elktoe	SC	
Alasmidonta viridis		SC	
Cyclonaias tuberculata		SC	
Epioblasma triquetra		E	
Pleurobema coccineum	Round pigtoe	SC	
Simpsoniconcha ambigua	Salamander mussel	E	
Venustaconcha ellipsiformis	Ellipse	SC	
Villosa fabalis	Bean villosa	E	

* reported from site

** Historical occurrence (>20 years old)

E= endangered, T= threatened, SC=state special concern

LE= Listed endangered under the Federal Endangered Species Act

LT= Listed threatened under the Federal Endangered Species Act



Mesic Southern Forest: Potential Elements- Galien River

Scientific Name	Common Name	MI Status	US Status
Plants:			
<i>Carex oligocarpa</i>	Eastern few-fruited sedge	T	
<i>Carex platyphylla</i>		T	
<i>Castanea dentata</i>		T	
<i>Dentaria maxima</i>		T	
**Diarrhena americana		ST	
<i>Galearis spectabilis</i>		T	
<i>Geum virginianum</i>		SC	
<i>Gymnocladus dioicus</i>		SC	
**Hybanthus concolor		SC	
<i>Hydrastis canadensis</i>		T	
<i>Smilax herbacea</i>		SC	
<i>Panax quinquefolius</i>		ST	
<i>Polymnia uvedalia</i>		T	
<i>Tipularia discolor</i>		T	
<i>Trillium nivale</i>		T	
*Trillium recurvatum		ST	
<i>Trillium sessile</i>		T	
<i>Trillium undulatum</i>		E	
<i>Triphora trianthophora</i>		T	
<i>Jeffersonia diphylla</i>		SC	
Birds:			
<i>Accipiter cooperii</i>	Cooper's hawk	SC	
*Buteo lineatus	Red-shouldered hawk	ST	
		SC	
		SC	
		SC	
Herps:			
*Acris crepitans blanchardii	Blanchard's cricket frog	SC	
<i>Ambystoma opacum</i>	Marbled salamander	ST	
<i>Terrapene c. carolina</i>	Eastern box turtle	SC	
Insects:			
<i>Dryobius sexnotatus</i>	Six-banded longhorn beetle	SC	
Mammals:			
**Microtus pinetorum	Woodland vole	SC	

* reported from site

**historical occurrence (>20 years old)

E= endangered, T= threatened, SC=state special concern

LE= Listed endangered under the Federal Endangered Species Act

LT= Listed threatened under the Federal Endangered Species Act

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Old Growth Forest 1 – Rare



Prairie Trillium 1 - Threatened



Fowler's Toad 2 - Range Restricted



Blow Down/Canopy Gap 1

WARREN WOODS NATURAL AREA

Field Trip Leader
Kim Herman
Michigan Department of
Natural Resources

Galien River Tour
October 29, 2001

Photos by
Dave Kenyon -1
Jeremy Burgdoff - 2

Values

Old Growth Forest
Floodplain
Vernal Ponds
Galien River
> 311 Native Plants
36 Tree Species
Wildflowers
Migratory Birds
Area Sensitive Birds
Amphibians/Reptiles
Rare Species
Enjoyment
Hiking
Photography
Bird Watching
Research
Education

Ecosystem Model

Threats

Forest Fragmentation
Small Size
Catastrophic Loss
Edge Effects
Unmitigated Flooding
Siltation
Erosion
Roads
Invasive Species
(plants, animals, disease)



Galien River 1



Yellow Throated Warbler 1 – Area Sensitive



Vernal Pond 1

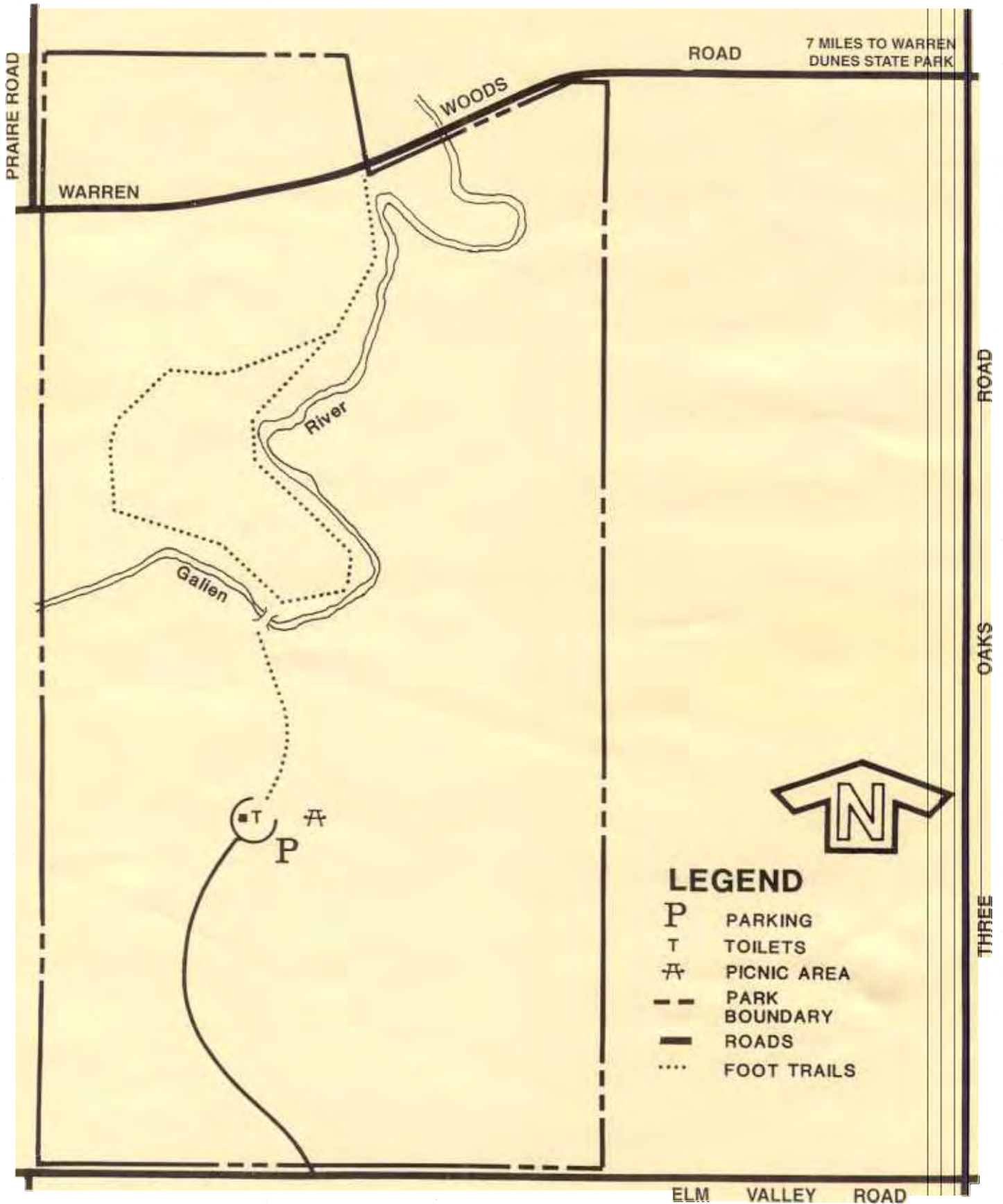


Garlic Mustard 2 – Invasive Exotic



DNR Michigan Department of Natural Resources
Parks and Recreation Division

Warren Woods Natural Area



Galien River Road Stream Crossing Summary

Category				
Priority Rankings	6 high	18 medium	221 low	
Aquatic Plants	5 abundant	44 present		
Floating Algae	14 abundant	14 present		
Filamentous Algae	13 abundant	21 present		
Bacterial Slime	2 present			
Turbidity	1 abundant	38 present		
Oil Sheen	1 abundant	4 present		
Foam	2 abundant	5 present		
Trash	2 present			
Sand%	161 ≥80%			
Silt / Detritus / Muck%	12 ≥80%			
Undercut Banks	13			
Overhanging Vegetation	210			
Deep Pools	23			
Boulders	16			
Aquatic Plant Cover	40			
Logs Woody Debris	145			
Riffle	5 abundant	33 present		
Pool	6 abundant	21 present		
Channel	199 natural	43 recovering		
Riparian Vegetation Width on Left (Feet)	112 <10	26 10-30	12 30-100	92 >100
Riparian Vegetation Width on Right (Feet)	109 <10	30 10-30	5 30-100	98 >100
Bank Erosion	1 moderate	37 low		
Stream Canopy %	62 <25%	73 25-50%	106 >50%	
Pasture	7			
Crop Residue	5			
Row Crop	92			
Residential Lawn / Park	80			
Impervious	44			
Disturbed Ground	2			
No Vegetation	5			
Crop Nonpoint Source (NPS)	97			
Grazing NPS	5			
Animal Feeding Operation NPS	4			
Transportation NPS	222			
Channelization	3			
Riparian Vegetation Removal	1			
Streambank Erosion	2			
Hydrology	1			
Upstream Impoundment	5			
Road Bridge Construction	7			
Development Construction	3			
Urban / Residential Runoff	34			
Land Disposal	2			
Septic Systems	2			
Recreational NPS	5			
Boating Water Release	3			
Boating Bank Erosion	3			
Debris In Water	1			
Unknown NPS	14			

Michigan Department of Environmental Quality

Surface Water Quality Division

February 2002

**Total Maximum Daily Load for *Escherichia Coli* in the Galien River,
Berrien County**

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable levels of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore then maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli* (*E. coli*) that will result in the attainment of the applicable WQS in the Galien River, located in Berrien County.

PROBLEM STATEMENT

This TMDL addresses approximately two miles of the Galien River near New Troy where recreational uses are impaired by elevated levels of pathogens. Michigan's Section 303(d) list (Creal and Wuycheck, 2000) cites the upstream terminus as the confluence of the east branch of the Galien River and the downstream terminus as the confluence of Kirktown Creek. The TMDL reach is on the Section 303(d) list as:

Waterbody: **Galien River**

WBID#: **083301A**

County: **Berrien**

RF3RchID: 4040001 23 Size: 2 M

Location: Galien River in the vicinity of New Troy – 1.0 mile d/s of Avery Road to 1.0 mile u/s of Avery Road (Kirktown Creek confluence u/s to the E. Br. Galien River confluence).

Status: **2** Problem: **WQS exceedances for *E. coli*; CSO, pathogens (Rule 100).**

TMDL YEAR(s): **2000**

The Galien River was placed on the Section 303(d) list due to impairment of recreational uses by the presence of elevated levels of *E. coli*. Historical data collected by the Berrien County Health Department documented elevated levels of *E. coli* in 1996. Monitoring data (Appendix 1) collected in 2001 by the MDEQ documented exceedances of the WQS, in both the Galien River and tributaries, at all eight stations (Table 1). Seasonal geometric means for the 2001 sampling season exhibited elevated levels at stations above and below the listed reach (Figure 3).

Monthly geometric mean *E. coli* concentrations in the Galien River for 2001 ranged from 266 *E. coli* per 100 milliliters (ml) in September at Elm Valley Road to 1,546 *E. coli* per 100 ml in May at Minnich Road (Table 1). Overall, the highest *E. coli* data collected in the Galien River were at Avery/Mill Road and Minnich Road. Both of these stations routinely exceeded 1,000 *E. coli* per 100 ml, with maximum results of 2,900 *E. coli* per 100 ml and 4,300 *E. coli* per 100 ml, respectively (Table 1).

Monthly geometric mean *E. coli* data in the tributaries sampled ranged from 411 *E. coli* per 100 ml in September in Kirktown Creek at Weechick Road to 5,066 *E. coli* per 100 ml in September in the east branch of the Galien River. The 2001 data collected indicate that the east branch of the Galien River may be a substantial source of *E. coli* to the main branch (Table 1).

Based on the 2001 monitoring data collected by the MDEQ, the upstream boundary has been extended to Elm Valley Road and the downstream boundary extended to Flynn Road (Figure 1). This modified reach includes both Kirktown Creek and the east branch of the Galien River since monitoring data indicates exceedances on these tributaries as well. The source area for the TMDL includes all the tributaries and land upstream of Flynn Rd (Figure 2).

Besides *E. coli*, the official 303(d) listing erroneously states a combined sewer overflow (CSO) problem in the Galien River. There are no permitted CSOs in the listed reach; therefore, this TMDL does not address the issue of CSOs. The listing was corrected to delete the reference to CSOs.

NUMERIC TARGETS

The impaired designated use for the Galien River at this location is total body contact. Rule 100 of the Michigan WQS requires that this waterbody be protected for total body contact recreation from May 1 to October 31. The target levels for this designated use are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

R 323.1062 Microorganisms.

Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *Escherichia coli* (*E. coli*) per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 *E. coli* per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

in addition, there is one permitted wastewater sewage lagoon (WWSL) discharge to the Galien River, which has an additional target:

Rule 62. (3) Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 milliliters, based on the geometric mean of all of 5 or more samples taken over a 30-day period, nor more than 400 fecal coliform bacteria per 100 milliliters, based on the on the geometric mean of all of 3 or more samples taken during any period of discharge not to exceed 7 days. Other indicators of adequate disinfection may be utilized where approved by the department.

The WWSL is permitted to discharge during the months of March through May and October through December. The discharge period overlaps the recreational season in May and October only and will be considered in compliance with the WQS of 130 *E. coli* per 100 ml if their National Pollutant Discharge Elimination System (NPDES) permit limit of 200 fecal coliform per 100 ml as a monthly average is met. This is assumed because *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). When the wastewater of concern is sewage, fecal coliform is substantially higher than *E. coli* (Whitman, 2001). When the point source discharge is meeting their limit of 200 fecal coliform per 100 ml, it can reasonably be assumed that there are less than 130 *E. coli* per 100 ml in the effluent.

For this TMDL, the WQS of 130 per 100 ml as a 30-day geometric mean is the target level for the TMDL reach from May 1 to October 31. As previously stated, 2001 monitoring data indicated consistent exceedances of WQS at all eight stations sampled. One heavy rain event

coincided with sampling on August 16, 2001. The consistent *E. coli* exceedances from May to September indicate a constant source of *E. coli* to both the Galien River and the tributaries sampled, regardless of wet weather events.

SOURCE ASSESSMENT

The modified listed TMDL reach for the Galien River is Elm Valley Road (upstream boundary) to Flynn Road (downstream boundary) (Figure 1). In addition, the source area for this TMDL includes the area upstream of Flynn Road and all tributaries. This is based on the 2001 monitoring data documenting exceedances at all sampling locations. The townships in the source area include Weesaw Township, Galien Township, Chikaming Township, Buchanan Township, Baroda Township, Bertrand Township, Three Oaks Township, and Oronok Township (Figure 2). Table 2 shows the distribution of land in the source area for each township.

Potential pathogen sources for this waterbody include agricultural inputs, since a majority of the surrounding land is used for agricultural production and to a lesser degree, urban land uses. Much of the watershed has been ditched and tiled to more efficiently drain water from the land. MDEQ staff have reported agricultural impacts, such as unlimited cattle access, to the east branch of the Galien River, which may explain the consistent exceedances from May to September. Other potential sources may be illicit connections to storm drains in the villages of New Troy and Galien, as well as storm water runoff. There are no known continuous point source discharges in this reach; however, there is one permitted seasonal lagoon discharge - the Galien WWSL (MIG580299). As previously discussed, this facility's discharge overlaps with the recreational season in May and October only and is not considered a significant source of *E. coli* as indicated by discharge monitoring results reported to MDEQ staff.

LINKAGE ANALYSIS

The link between the *E. coli* concentration in the Galien River and the potential sources is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and the sources. This provides the basis for estimating the total assimilative capacity of the river and any needed load reductions. For this TMDL, the primary loading of pathogens appears to enter the Galien River by both wet and dry weather conditions and storm water related nonpoint sources.

Based on 2001 monitoring data, the background concentration of *E. coli* was found to be exceeding the WQS. This conclusion was the basis for redefining the TMDL reach with an extended source area. Additional data will be collected during the 2002 sampling season to document existing conditions. The guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in the Galien River depends on the continued control of point source *E. coli*, and the control of *E. coli* in storm water, illicit connections, and agricultural inputs. If the *E. coli* inputs can be controlled, then total body contact recreation in the Galien River will be protected.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving WQS. As indicated in the Numeric Targets section, the target for this pathogen TMDL is the WQS of 130 *E. coli* per 100 ml. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the environmental conditions that will be used when defining allowable levels. Many TMDLs are designed around the concept of a "critical condition." The "critical condition" is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical conditions for the control of point sources in Michigan are given in R 323.1090. In general, the lowest monthly 95% exceedance flow for streams is used as a design condition for point source discharges. However, for pathogens in point source discharges of treated or untreated human sewage, levels are restricted to a monthly average limit of 200 per 100 ml for fecal coliforms regardless of stream flow. Therefore, the design stream flow is not a critical condition for determining the allowable loadings for the WWTP. In addition, other *E. coli* sources to the Galien River arise from a mixture of dry and wet weather-driven sources, and there is no single critical condition that is protective for all other conditions. For these sources, there are a number of different allowable loads that will all ensure compliance, as long as they are distributed properly throughout the watershed.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For *E. coli* indicators, however, mass is not an appropriate measure, and the USEPA allows pathogen TMDLs to be expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). Therefore, this pathogen TMDL is concentration-based consistent with R 323.1062, and the TMDL is equal to the target concentration of 130 *E. coli* per 100 ml.

For this TMDL, an allocation strategy for nonpoint sources has been selected that assumes equal bacteria loads per unit area for all lands within the watershed. The point sources are

handled consistent with Rule 62(3). The allocation process for each month of the recreational season (May through October) is outlined below.

1. This TMDL is concentration-based, so the TMDL is equal to the pathogen WQS of 130 *E. coli* per 100 ml.
2. There are no known continuous point source discharges of *E. coli* in the watershed; however, there is one permitted lagoon discharge. The Galien WWSL (MIG580299) has a seasonal discharge during the months of March through May and October through December. The facility has a fecal coliform limit of 200 per 100 ml as a monthly average. The WWTP will be considered in compliance with the WQS of 130 *E. coli* per 100 ml if their NPDES permit limit of 200 fecal coliform per 100 ml as a monthly average is met. As previously discussed, this is assumed because *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). When the wastewater of concern is sewage, fecal coliform is substantially higher than *E. coli* (Whitman, 2001). When the point source discharge is meeting their limit of 200 fecal coliform per 100 ml, it can reasonably be assumed that there are less than 130 *E. coli* per 100 ml in the effluent.
3. Monitoring data collected in 2001 indicated exceedances of the WQS at all locations sampled. Due to this, the TMDL reach was extended downstream to Flynn Road and upstream to Elm Valley Road (Figure 1) and the entire watershed upstream of Flynn Road is now included as a source area (Figure 2).

Consistent with the allocation strategy, Table 3 shows the TMDL or allowable concentrations for *E. coli* by applicable month in the Galien River watershed.

ALLOCATIONS

TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an MOS, either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. As previously indicated, this pathogen TMDL will not be expressed on a mass loading basis and is concentration-based consistent with USEPA regulations at 40 CFR, Section 130.2(1).

WLAs

The Galien WWTP (MIG580299) is the only permitted point source discharge to the listed reach of the Galien River. This facility has a seasonal discharge during the months of March through May and October through December and has a fecal coliform limit of 200 per 100 ml as a monthly average. As previously stated, when the WWTP is meeting their permit limit, it is assumed the WQS will be met in the discharge. Therefore, the WLA will be equal to 130 *E. coli* per 100 ml for the months of May and October.

LAs

Due to WQS exceedances at all locations sampled, the source area has been extended to include the entire reach of the watershed. This TMDL is concentration-based; therefore, the LA is equal to 130 *E. coli* per 100 ml, and the determination of individual LAs will be based on the assumption of equal bacteria loads per unit area for all lands within the watershed. Therefore, the relative responsibility for achieving the necessary reductions of bacteria and maintaining acceptable conditions will be determined by the amount of land under the jurisdiction of the various local units of government within the watershed. Table 2 gives the relative LAs for each of the local units of governments. This gives a clear indication of the relative amount of effort that will be required by each entity to restore and maintain the total body contact designated uses to the Galien River.

The government entities with the largest percent land area in the Galien River watershed are Weesaw Township --which includes the village of New Troy-- (35%) and Galien Township (22%), making up 57% of the watershed. The remaining 43% of the watershed is made of Chikaming Township (16%), Buchanan Township (14%), Baroda Township (6%), Bertrand Township (3%), Three Oaks Township (3%), and Oronok Township (1%).

MOS

This section addresses the incorporation of an MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS because no rate of decay was used.

Example Loading Assessment

Although this TMDL is concentration-based, an example calculation using counts per day was used to simulate a loading assessment. The TMDL, on a loading basis, can be calculated as a function of stream flow using the following equation:

$$\text{TMDL} = Q_{\text{riv},x} \times C_{\text{WQS}}$$

Where:

TMDL = Loading capacity in the river (counts per time).

$Q_{\text{riv},x}$ = River flow (volume of water per time).

C_{WQS} = WQS concentration (counts per volume of water).

The loading capacity defined in the above equation applies to all river flows for which WQS apply. The monthly average flows for the Galien River at Flynn Road are given in Tables 4 and 5 and were used to calculate the total allowable load to the Galien River.

Using the previously stated conditions from the allocation strategy, the allocations based on average flow conditions were determined using the following process:

1. For the Galien River, the allowable concentrations were converted to allowable loads.
2. LAs were determined for each local entity based on the relative areas of jurisdiction within each subwatershed. These results are given in Table 6.
3. The WLA was determined for the village of Galien based on their annual permitted discharge of 50.55 million gallons. A design flow was calculated using a six month discharge period and assuming a regular lagoon discharge scenario of ten days on,

seven days off for a flow of 0.42 million gallons per day, respectively. This flow was used to calculate the WLA for May and October only, the months the discharge overlaps with the recreational season. These results are given in Table 7.

4. The Galien River flows used in calculations for the LAs were taken at Flynn Road. The flow data was provided by the Hydrology Unit, Land and Water Management Division, MDEQ.
5. The TMDL total load was calculated using the flow of the Galien River, which includes the design flow of the WWSL for May and October, and uses the formula in Table 7.

The results of the loading assessment for the listed reach of the Galien River under average flow conditions are given in Table 7. The assessment shows primarily that if the LAs are met, the TMDL will not be exceeded in the Galien River at Flynn Road for each month of the recreational season.

SEASONALITY

Seasonality in the TMDL is addressed by expressing the TMDL in terms of a total body contact recreation season that is defined as May 1 through October 31 by Rule 323.1100 of the WQS. There is no total body contact during the remainder of the year primarily due to cold weather. In addition, because this is a concentration-based TMDL, WQS will be met regardless of flow conditions in the applicable season.

MONITORING

In 2001, water quality was monitored at eight stations from May to September (Figure 1). Subsequent weekly sampling will begin at appropriate stations in May 2002, and conclude in September 2002. If sampling in 2002 indicates WQS are exceeded, sampling will be oriented toward source identification. If these results indicate that the waterbody may be meeting WQS, sampling will be conducted at the appropriate frequency to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml is being met.

In future years, assuming WQS are not met immediately, additional sampling will be conducted from May to September at appropriate stations. Sampling will be adjusted as needed to assist in continued source identification and elimination. When these results indicate that the

waterbody may be meeting WQS, sampling will be conducted at the appropriate frequency to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml is being met.

REASONABLE ASSURANCE ACTIVITIES

Agricultural runoff and illicit discharges are likely the dominant source of *E. coli* to the Galien River, given the rural nature of the watershed. To a small degree, storm water runoff could potentially be another source as well. Implementation activities to meet the TMDL require measures to reduce *E. coli* sources and loads. Under the Phase 2 storm water regulations, municipalities in the watershed will be evaluated against applicable criteria and may be required to obtain Phase 2 storm water permits. These permits will likely require activities that reduce pathogen inputs.

In addition, the Berrien County Drain Commission has been awarded a Section 319 Watershed Management Grant that will include developing a comprehensive watershed management plan, implementing an Information and Education strategy that identifies target audiences and delivers messages based on the sources and causes of nonpoint solution, and conducting other activities aimed at restoring the Galien River watershed.

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January 25, 2002

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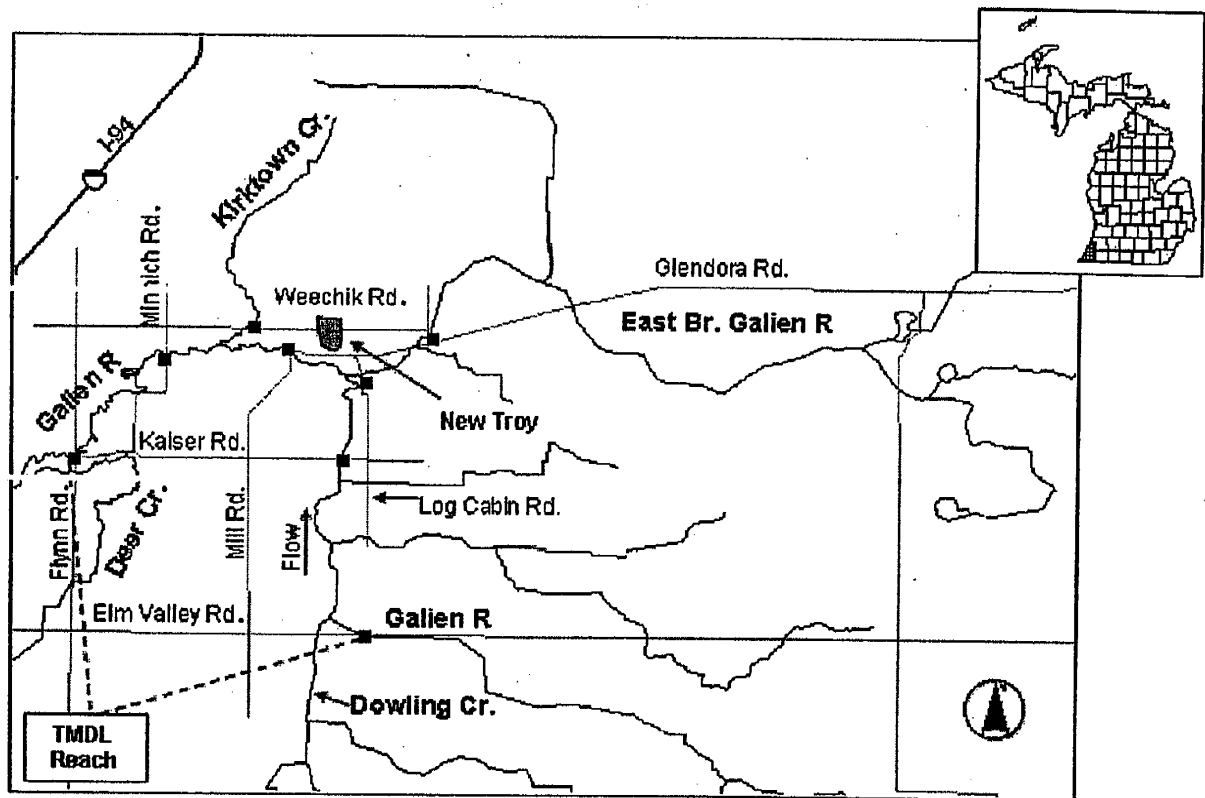


Figure 1. Sampling locations for the Galien River and selected tributaries, May through September 2001, Berrien County, Michigan.

Results of TMDL study

Galion River

- GR-1B = E. Branch of Gallien River @ Holden Rd.
- GR-2B = Kirkdown Creek @ Baldwin Rd.
- GR-3B = Gallien River @ Elm Valley Rd.
- GR-4A = Gallien River @ Kaiser Rd.
- GR-5B = Gallien River @ Flynn Rd.
- GR-6B = E. Branch of Gallien River @ Glendora Rd., east crossing
- GR-7A = Troy Drain (east drain), south of Glendora and State St. intersection
- GR-8A = New Troy Drain (west drain), south of Glendora and State St. intersection
- GR-9A = Dowling Creek @ US-12

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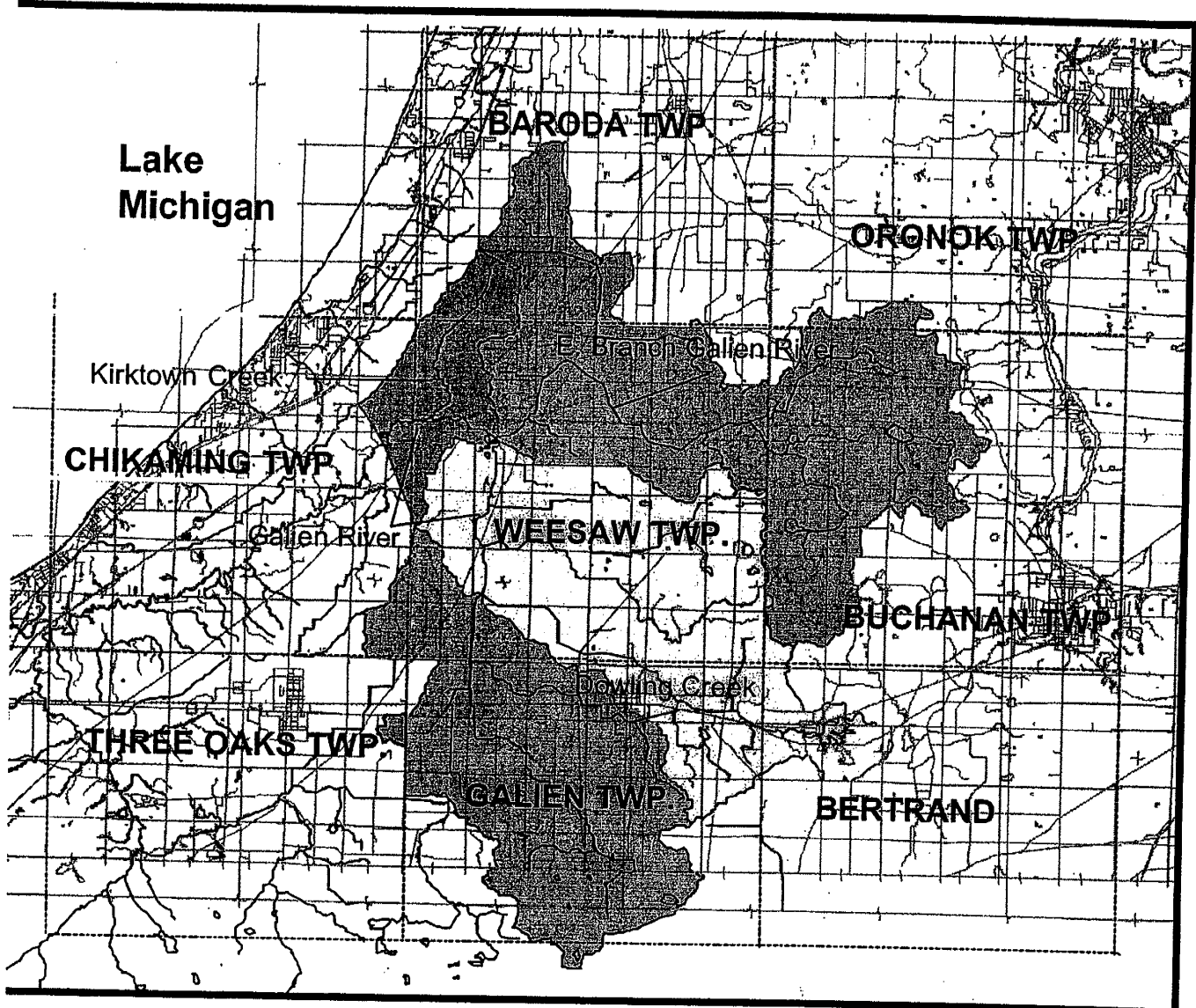


Figure 2. The shaded area indicates the townships included in the source area for the Galien River *E. coli* TMDL. The downstream end of the source area is at Flynn Road on the Galien River.

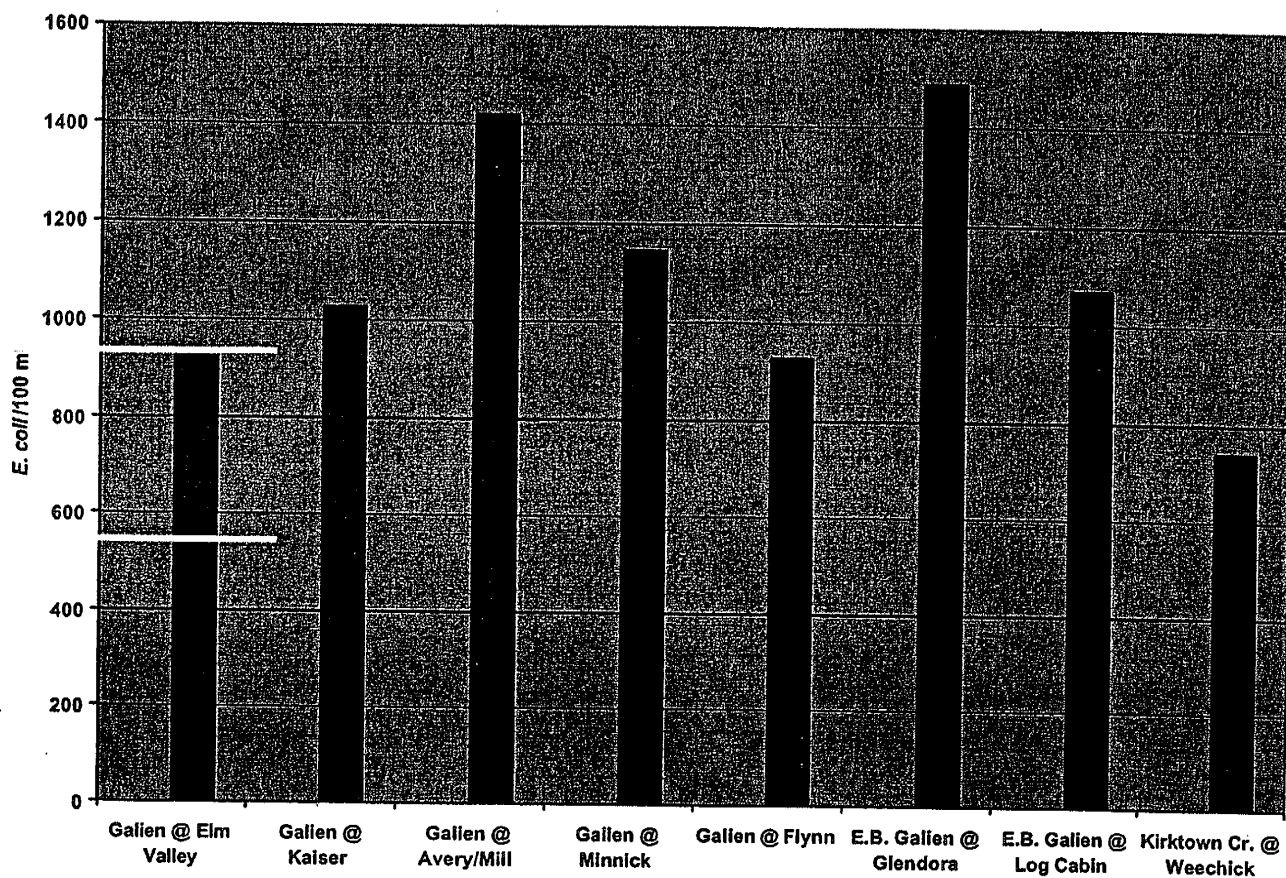


Figure 3. Seasonal geometric mean *E. coli* results for the Galien River and selected tributaries, Berrien County, Michigan, May through September, 2001. Data are presented upstream to downstream, followed by tributaries.

Table 1. MDEQ *E. coli* data for the Galien River in the vicinity of New Troy, Michigan, 2001.

Sample Location	Month	<i>E. coli</i> Concentration (#/100 ml)			# of Results
		Minimum	Geometric Mean	Maximum	
Galien @ Elm Valley Rd.	May	*	*	*	*
	June	420	682	1,170	6
	July	520	1,072	1,900	12
	August	330	1,213	5,500	15
	September	180	266	350	3
Galien @ Kaiser Rd.	May	880	952	1,000	3
	June	490	1,236	2,700	12
	July	580	924	1,400	12
	August	390	1,104	5,000	15
	September	520	565	630	3
Galien @ Avery/Mill Rd.	May	1,200	1,285	1,360	3
	June	1,120	1,495	2,900	6
	July	*	*	*	*
	August	*	*	*	*
	September	*	*	*	*
Galien @ Minnich Rd.	May	1,450	1,546	1,700	3
	June	590	1,018	2,200	12
	July	790	1,255	3,000	12
	August	480	1,180	4,300	15
	September	800	832	890	3
Galien @ Flynn Rd.	May	*	*	*	*
	June	480	991	2,000	6
	July	610	939	1,400	12
	August	400	932	2,900	15
	September	730	779	810	3
E.B. Galien @ Glendora Rd.	May	1,100	1,327	1,700	3
	June	560	1,033	2,800	12
	July	690	1,471	4,000	11
	August	840	1,608	3,500	15
	September	5,000	5,066	5,100	3
E.B. Galien @ Log Cabin Rd.	May	1,300	1,417	1,500	3
	June	600	931	1,160	6
	July	*	*	*	*
	August	*	*	*	*
	September	*	*	*	*
Kirktown Cr. @ Weechick Rd.	May	1,100	1,301	1,600	3
	June	440	807	1,800	12
	July	340	696	1,830	12
	August	250	729	1,300	15
	September	380	411	470	3

no data collected during this month at this location.

Table 2. Distribution of land for each municipality in the source area.

<u>Municipality</u>	<u>Square Miles</u>	<u>Percent</u>
Neesaw Township	34.9	43
Galien Township	22.0	27
Buchanan Township	13.6	17
Baroda Township	5.6	7
Bertrand Township	2.5	3
Chikaming Township	1.2	1
Dronok Township	1.0	1
Three Oaks Township	0.4	1
TOTAL	81.2	100

Table 3. Allowable *E. coli* concentrations by month in the Galien River watershed.

<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>	<u>October</u>
130	130	130	130	130	130

Table 4. Galien River average flows (cfs) at Flynn Road.

<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>	<u>October</u>
86	62	43	38	36	41

Table 5. Galien River average flows (cfs), including the Galien WWSL flows.

<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>	<u>October</u>
86.7	62	43	38	36	41.7

Table 6. LAs for the Galien River watershed upstream of Flynn Road for average flow (relative loading units*).

	Percent land in watershed	May	June	July	August	September	October
Weesaw Twp.	43	117	85	59	52	49	56
Galien Twp.	27	74	53	37	33	31	35
Buchanan Twp.	17	46	33	23	21	19	22
Baroda Twp.	7	19	14	10	8	8	9
Bertrand Twp.	3	8	6	4	4	4	4
Chikaming Twp.	1	3	2	1	1	1	1
Three Oaks Twp.	1	3	2	1	1	1	1
Oronok Twp.	1	3	2	1	1	1	1
TOTAL	100	273	197	136	121	114	129

Relative Loading Units = *E. coli* concentration (130 counts/100 ml) x River flow (cfs) x (10 x .646 x 3.785) / 10³

Table 7. TMDL for the Galien River, May 1 to October 31 (relative loading units)*.

	May	June	July	August	September	October
WLA	2.1	0	0	0	0	2.1
LA	273	197	136	121	114	129
TOTAL LOAD (TMDL)	275.1	197	136	121	114	131.1

Relative Loading Units = *E. coli* concentration (130 counts/100 ml) x River flow or effluent flow (cfs) x (10 x .646 x 3.785) / 10³

Appendix 1. MDEQ *E. coli* monitoring data for the Galien River, vicinity of New Troy, 2001. Data are presented upstream to downstream, followed by tributaries.

Galien River @ Elm Valley Rd. GR-3B	Galien River @ Kaiser Rd. GR-4A	Galien River @ Avery/Mill Rd. GR-3A	Galien River @ Minnick Rd. GR-1A
6/20/2001	5/25/2001	5/25/2001	5/25/2001
420	1000	1300	1700
540	980	1200	1500
520	880	1360	1450
6/28/2001	6/6/2001	6/6/2001	6/6/2001
1170	2200	1500	2200
1120	2700	1300	2000
650	2200	2900	800
7/5/2001	6/13/2001	6/13/2001	6/13/2001
580	1320	1420	790
560	1220	1240	840
520	1140	1120	950
7/12/2001	6/20/2001		6/20/2001
1100	560		660
600	540		600
1000	490		590
7/26/2001	6/28/2001		6/28/2001
1570	1800		1120
1600	1100		1530
1480	1800		1390
7/19/2001	7/5/2001		7/5/2001
1400	600		900
1400	580		790
1500	620		810
8/2/2001	7/12/2001		7/17/2001
1020	980		1600
1070	1400		1300
1400	1000		1500
8/9/2001	7/26/2001		7/26/2001
1200	1020		850
1300	890		910
990	1020		830
8/16/2001	7/19/2001		7/19/2001
1100	1300		3000
1140	1000		2100
1070	1080		2100
8/23/2001	8/2/2001		8/2/2001
5500	860		1440
5500	800		2400
4700	900		1400
8/29/2001	8/9/2001		8/9/2001
330	910		480
340	920		550
360	920		510
9/4/2001	8/16/2001		8/16/2001
350	1000		1400
180	1400		1700
300	1600		1800
	8/23/2001		8/23/2001
	3500		4300
	3500		2200
	5000		2300
	8/29/2001		8/29/2001
	410		560
	420		580
	390		610
	9/4/2001		9/4/2001
	630		890
	550		810
	520		800

Appendix 1 continued.

Gallen River @ Flynn Rd. GR-5B	E. Branch Galien River @ Glendora Rd. GR-6A	E. Branch Galien River @ Log Cabin Rd. GR-5A	Kirktown Creek @ Weechick Rd. GR-2A
6/20/2001 550 480 510 6/28/2001 1900 1850 2000 7/5/2001 610 660 700 7/12/2001 1200 790 1400 7/26/2001 800 880 820 7/19/2001 1300 1400 1200 8/2/2001 800 540 700 8/9/2001 630 840 450 8/16/2001 1200 1400 1800 8/23/2001 2700 2900 2700 8/29/2001 400 410 460 9/4/2001 730 800 810	5/25/2001 1700 1100 1250 6/6/2001 1000 1030 1000 6/13/2001 770 730 560 6/20/2001 600 620 650 6/28/2001 2600 2800 2600 7/5/2001 710 690 720 7/12/2001 3500 4000 2400 7/26/2001 1050 1020 1090 7/19/2001 2100 2400 8/2/2001 2200 2300 2700 8/9/2001 3500 1700 2100 8/16/2001 1600 1800 2800 8/23/2001 970 1150 1220 8/29/2001 880 840 900 9/4/2001 5100 5100 5000	5/25/2001 1300 1460 1500 6/6/2001 800 910 600 6/13/2001 1160 1120 1150 6/20/2001 520 470 440 6/28/2001 530 500 500 7/5/2001 340 420 400 7/12/2001 540 470 520 7/26/2001 1830 1810 1770 7/19/2001 700 700 600 8/2/2001 1050 1200 1700 8/9/2001 480 530 520 8/16/2001 1300 1300 1300 8/23/2001 800 950 950 8/29/2001 250 270 290 9/4/2001 380 470 390	5/25/2001 1600 1100 1250 6/6/2001 1800 800 1800 6/13/2001 1140 1320 1370 6/20/2001 520 470 440 6/28/2001 530 500 500 7/5/2001 340 420 400 7/12/2001 540 470 520 7/26/2001 1830 1810 1770 7/19/2001 700 700 600 8/2/2001 1050 1200 1700 8/9/2001 480 530 520 8/16/2001 1300 1300 1300 8/23/2001 800 950 950 8/29/2001 250 270 290 9/4/2001 380 470 390

**Michigan Department of Environmental Quality
Surface Water Quality Division
August 2002**

**Total Maximum Daily Load for *Escherichia coli* for Deer Creek,
Berrien County, Michigan**

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli* (*E. coli*) that will result in the attainment of the applicable WQS in Deer Creek, a small waterbody with relatively low flows (Table 1) in the Galien River Watershed, located in Berrien County.

PROBLEM STATEMENT

Deer Creek was first placed on the Section 303(d) list in 1998. This TMDL addresses approximately seven miles of stream. The TMDL reach is on the 2002 Section 303(d) list (Creal and Wuycheck, 2002) as:

Waterbody:	Deer Creek	WBID#:	083301D
County:	Berrien	HUC:	4040001
		Size:	7 M
Location:	S. Br. Galien River confluence u/s to the headwaters in vicinity of Three Oaks		
Problem:	Untreated sewage discharge, pathogens (Rule 100); Macroinvertebrate community rated poor; nuisance algae		
TMDL YEAR(s):	2002 2004	RF3RchID:	4040001 440 0.00

This TMDL addresses pathogens. Deer Creek is also on the Section 303 (d) list for poor macroinvertebrate communities and nuisance algae. These TMDLS are scheduled in 2004.

Deer Creek (Figure 1) was placed on the Section 303(d) list for *E. coli* due to impairment of recreational uses as indicated by the presence of elevated levels of *E. coli*. Recent monitoring data (Appendix 1) collected by the Michigan Department of Environmental Quality (MDEQ) in 2001 documents continued exceedances of the WQS for *E. coli* at all Deer Creek stations sampled (Table 2), with exception of the September sampling at Lakeside Road. Monthly geometric mean *E. coli* concentrations in Deer Creek for 2001 ranged from 74 *E. coli* per 100 milliliter (ml) in September at Lakeside Road to 1,273 *E. coli* per 100 ml in June at Basswood Rd. (Table 2).

Other waterbodies sampled for this TMDL include Chestnut Drain and the South Branch of the Galien River. Chestnut Drain, a small tributary to the headwaters of Deer Creek, originates in the village of Three Oaks and exhibited the highest *E. coli* concentrations observed in the 2001 sampling (Table 2 and Figure 2). Concentrations ranged from 1,266 *E. coli* per 100 ml in June to 5,794 *E. coli* per 100 ml in May and the drain appears to be a substantial dry weather source of *E. coli* to Deer Creek. The South Branch of the Galien River was sampled upstream (Forest Lawn Road) and downstream (Lakeside Road) of the confluence with Deer Creek.

Slightly elevated levels of *E. coli* were found at both stations. Monthly geometric means at Forest Lawn Road (upstream) ranged from 334 *E. coli* per 100 ml in September to 698 *E. coli* per 100 ml in July. Monthly geometric means for *E. coli* at Lakeside Road (downstream) ranged from 266 *E. coli* per 100 ml in June to 730 *E. coli* per 100 ml in July.

NUMERIC TARGET

The impaired designated use for Deer Creek addressed by this TMDL is total body contact recreation. Rule 100 of the Michigan WQS requires that this waterbody be protected for total body contact recreation from May 1 to October 31. The target levels for this designated use are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

R 323.1062 Microorganisms.

Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *Escherichia coli* (*E. coli*) per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 *E. coli* per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

In addition, permitted sanitary wastewater discharges have an additional target:

Rule 62. (3) Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 milliliters, based on the geometric mean of all of 5 or more samples taken over a 30-day period, nor more than 400 fecal coliform bacteria per 100 milliliters, based on the on the geometric mean of all of 3 or more samples taken during any period of discharge not to exceed 7 days. Other indicators of adequate disinfection may be utilized where approved by the department.

Sanitary wastewater discharges are considered in compliance with the WQS of 130 *E. coli* per 100 ml if their National Pollutant Discharge Elimination System (NPDES) permit limit of 200 fecal coliforms per 100 ml as a monthly average is met. This is assumed because *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). When the wastewater of concern is sewage, fecal coliform is substantially higher than *E. coli* (Whitman, 2001). When the point source dischargers are meeting their limit of 200 fecal coliform per 100 ml, it can reasonably be assumed that there are less than 130 *E. coli* per 100 ml in the effluent.

For this TMDL, the WQS of 130 per 100 ml as a 30-day geometric mean is the target level for the TMDL reach from May 1 to October 31. As previously stated, 2001 monitoring data indicated consistent exceedances of WQS in the TMDL reach with particularly high levels of *E. coli* in Chestnut Drain in the village of Three Oaks.

SOURCE ASSESSMENT

Deer Creek is located entirely in Three Oaks Township in Berrien County. The TMDL reach is from the confluence of Deer Creek with the South Branch of the Galien River upstream to the headwaters in the vicinity of the village of Three Oaks (Figure 1). There are two permitted point

source discharges to Deer Creek, the Three Oaks Waste Water Sewage Lagoon (WWSL) (MIG580294) and Vickers Engineering (MIS410232). Municipalities include Three Oaks Township and the village of Three Oaks (Figure 3).

Potential pathogen sources for this waterbody appear to be due in part to storm water from the village of Three Oaks, illicit connections, sewage overflows, and agricultural inputs. The 2001 monitoring data was collected during typical stream flow conditions and indicates both continuous and storm water-related inputs.

As stated above, there are two permitted point source discharges to Deer Creek, Vickers Engineering and the Three Oaks WWSL. Vickers Engineering has a permitted storm water discharge to Deer Creek. In addition to storm water, this facility has a septic tank drain field used for treatment of their sanitary and industry discharge. By the aid of an economic development grant, the facility's sanitary and industrial waste will be discharged to the village of Three Oaks sanitary sewer system (MDEQ district correspondence, 2002), eliminating any potential inputs to Deer Creek from their septic tank.

The Three Oaks WWSL is permitted to discharge during the months of March through May and October through December. The discharge period overlaps the recreational season in May and October only. The facility has a fecal coliform limit of 200 per 100 ml as a monthly average and will be considered in compliance with the WQS of 130 *E. coli* per 100 ml if their NPDES permit limit of 200 fecal coliform per 100 ml as a monthly average is met. As previously discussed, this is assumed because *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). When the wastewater of concern is sewage, fecal coliform is substantially higher than *E. coli* (Whitman, 2001). When the point source is meeting their limit of 200 fecal coliform of 100 ml, it can reasonably be assumed that there are less than 130 *E. coli* per 100 ml in the effluent. However, records maintained by the MDEQ document an overflow from the Three Oaks WWSL and an out of season discharge in 1997 and 2000, resulting in bacterial slime growth in Deer Creek. The village of Three Oaks is currently under an Administrative Consent Order (ACO) (SW99-007) to separate their sanitary sewer lines from their storm sewers. The project is expected to be completed by March 1, 2003. In addition, monitoring data collected in 2001 indicate Chestnut Drain, originating in Three Oaks, is a substantial source of *E. coli* even in dry weather (Appendix 1).

LINKAGE ANALYSIS

The link between the *E. coli* concentration in Deer Creek and the potential sources is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and the sources. This provides the basis for estimating the total assimilative capacity of the creek and any needed load reductions. For this TMDL, the primary loading of pathogens likely enters Deer Creek by both continuous and, to some degree, storm water related nonpoint sources.

The guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in Deer Creek depends on the control of point source *E. coli*, the control of *E. coli* in illicit connections, and storm water. If the *E. coli* inputs can be controlled, then total body contact recreation in Deer Creek will be protected.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving WQS. As indicated in the Numeric Target section, the target for this pathogen TMDL is the WQS of 130 *E. coli* per 100 ml. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the environmental conditions that will be used when defining allowable levels. Many TMDLs are designed around the concept of a "critical

condition.” The “critical condition” is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical conditions for the control of point sources in Michigan are given in R 323.1082 and R 323.1090. In general, the lowest monthly 95% exceedance flow for streams is used as a design condition for point source discharges. However, for pathogens in point source discharges of treated or untreated human sewage, levels are restricted to a monthly average limit of 200 per 100 ml for fecal coliform regardless of stream flow. Therefore, the design stream flow is not a critical condition for determining the allowable loading of pathogens for wastewater treatment plants. In addition, other *E. coli* sources to Deer Creek arise from a mixture of wet and dry weather-driven nonpoint sources, and there is no single critical condition that is protective for all other conditions. For these sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For *E. coli*, however, mass is not an appropriate measure, and the USEPA allows pathogen TMDLs to be expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). Therefore, this pathogen TMDL is concentration-based consistent with R 323.1062, and the TMDL at the confluence with the South Branch of the Galien River is equal to the target concentration of 130 *E. coli* per 100 ml for each month of the recreational season (May through October).

For this TMDL, an allocation strategy for nonpoint sources has been selected that assumes equal bacteria loads per unit area for all lands within the watershed. The point sources are handled consistent with Rule 62(3).

ALLOCATIONS

TMDLs are comprised of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. As previously indicated, this pathogen TMDL will not be expressed on a mass loading basis and is concentration-based consistent with USEPA regulations in 40 CFR, Section 130.2(i).

WLAs

The village of Three Oaks WWSL (MIG580294) is the only permitted point source discharge that contains treated or untreated human sewage to the listed reach of Deer Creek. This facility has a seasonal discharge during the months of March through May and October through December and has a limit of 200 fecal coliform per 100 ml as a monthly average. As previously stated, when the WWSL is meeting their fecal coliform limit, it is assumed the WQS will be met in the discharge. Therefore, the WLA will be equal to 130 *E. coli* per 100 ml for the months of May and October.

LA's

Because this TMDL is concentration-based, the LA is equal to 130 *E. coli* per 100 ml. The assumption used in the allocation strategy is that there are equal bacteria loads per unit area for all lands within the watershed. Therefore, the relative responsibility for achieving the necessary reductions of bacteria and maintaining acceptable conditions will be determined by the amount of land under the jurisdiction of the various units of local government within the watershed. Table 3 gives the relative land in the watershed for each of the local units of governments. This gives a clear indication of the relative amount of effort that will be required by each entity to restore and maintain the total body contact designated uses to Deer Creek. However, as noted previously, Chestnut Drain located in the village of Three Oaks appears to be a significant source of *E. coli* to Deer Creek. It is anticipated that this problem will be addressed under the current Administrative Consent Order (ACO) and on-going construction of a new sanitary sewer system within the village limits of Three Oaks.

The government entities with land area in the Deer Creek Watershed are Three Oaks Township (87%), followed by the village of Three Oaks (13%) (Table 3).

MOS

This section addresses the incorporation of an MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS because no rate of decay was used.

SEASONALITY

Seasonality in the TMDL is addressed by expressing the TMDL in terms of a total body contact recreation season that is defined as May 1 through October 31 by R 323.1100 of the WQS. There is no total body contact during the remainder of the year primarily due to cold weather. In addition, because this is a concentration-based TMDL, WQS will be met regardless of flow conditions in the applicable season.

MONITORING

In 2001, pathogens were monitored at seven stations from May through September (Figure 1). Subsequent weekly sampling began at all stations on May 15, 2002 and will continue through September, 2002. If sampling in early in 2002 continues to show that WQS are exceeded, sampling will be oriented towards source identification. If these results indicate that the waterbody may be meeting WQS, sampling will be conducted at the appropriate frequency to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml is being met.

Future monitoring will be conducted at appropriate stations after March 1, 2003. All hook-ups to the sanitary sewer are required by the ACO to be completed by this date. When results indicate that the waterbody may be meeting WQS, sampling will be conducted at the appropriate frequency to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml is being met.

REASONABLE ASSURANCE ACTIVITIES

Due to numerous past unauthorized lagoon discharges, sewer extensions, and lift station failures, the village of Three Oaks is under an ACO (SW99-007) to update their sanitary sewer system. The upgraded system will eliminate excessive infiltration and inflow, which will alleviate overflows from the lagoons. All construction and residential hook-ups are required by the ACO by March 1, 2003, although the project is anticipated to be completed before that date.

The Berrien County Drain Commission has been awarded a Section 319 Watershed Management Grant. The grant includes the development of a comprehensive watershed management plan and implementing an Information and Education strategy that identifies target audiences and delivers messages based on the sources and causes of nonpoint solution. The group began meeting in 2001 to conduct activities aimed at restoring the Galien River watershed.

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Michigan Department of Environmental Quality
August 26, 2002

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GALIEN RIVER WATERSHED
Results of TMDL study

Deer Creek

Sample Date	5/2/2002	5/8/2002	5/15/2002	5/22/2002	5/29/2002	6/5/2002	6/12/2002	6/19/2002	6/26/2002	7/3/2002	7/10/2002	7/17/2002	7/24/2002	7/31/2002	8/7/2002	8/14/2002	8/21/2002	8/28/2002	9/4/2002	9/11/2002	9/18/2002	9/25/2002
Lab	5/2/2002	5/8/2002	5/15/2002	5/22/2002	5/29/2002	6/5/2002	6/12/2002	6/19/2002	6/26/2002	7/3/2002	7/10/2002	7/17/2002	7/24/2002	7/31/2002	8/7/2002	8/14/2002	8/21/2002	8/28/2002	9/4/2002	9/11/2002	9/18/2002	9/25/2002
Location	DC-1A-1	DC-1A-2	DC-1A-3	DC-2B-1	DC-2B-2	DC-2B-3	DC-3B-1	DC-3B-2	DC-3B-3	DC-4A-1	DC-4A-2	DC-4A-3	DC-5A-1	DC-5A-2	DC-5A-3	DC-2	DC-3					
	58	310	310	500	410	150	380	420	610	1800	790	2700	820	820	800	1800	800	1100	720	770	1200	840
	28	300	480	480	310	140	350	420	540	1500	780	2800	620	780	800	1500	800	600	630	870	1300	880
	38	300	430	430	350	140	280	430	590	1800	900	2300	1000	1000	770	1300	800	790	1100	1300	1400	840
	66	230	400	400	220	300	430	750	370	1400	800	2300	920	520	740	1500	800	1100	720	850	1200	880
	70	220	350	350	180	310	320	640	450	1400	700	1800	780	550	510	1400	800	600	630	1100	1100	920
	52	290	400	400	170	280	410	620	440	2000	780	4100	730	1000	700	1100	570	640	710	1000	1000	900
	86	220	420	420	310	340	440	590	480	2800	590	2600	980	980	840	3800	610	570	570	1000	1100	780
	52	230	310	310	340	280	640	570	470	1600	910	2400	980	700	630	3200	890	640	710	1300	1000	1200
	28	250	430	430	360	320	510	480	610	1300	730	2200	1100	800	510	2300	820	790	840	860	1300	840
	86	120	30	40	140	140	40	120	820	520	7300	7300	1100	800	900	2300	820	790	840	860	1300	840
	18	110	40	70	130	130	80	260	DRY	590	DRY	5000	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	12	100	42	50	200	290	290	<10	450	450	5700	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	86	1700	1300	2900	8200	8200	4200	4300	31000	31000	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	50	TNTC	3300	2620	7800	7800	4500	3700	60000	67000	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	86	TNTC	3000	3100	5300	5300	5900	3300	67000	67000	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	NA	< 1	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 10	NA	< 10	NA	NA	NA	NA	NA	NA	NA	NA
	< 2	NA	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10

DC-1A = Deer Creek @ Lakeside Rd.
DC-2B = S. Branch Gallien River @ Lakeside Rd.
DC-3B = S. Branch Gallien River @ Forest Lawn Rd.
DC-4A = Deer Creek @ Schward Rd.
DC-5A = Chestnut Dr. in Three Oaks

**DC-2 is a time blank taken at station 2
**DC-3 is a time blank taken at station 3

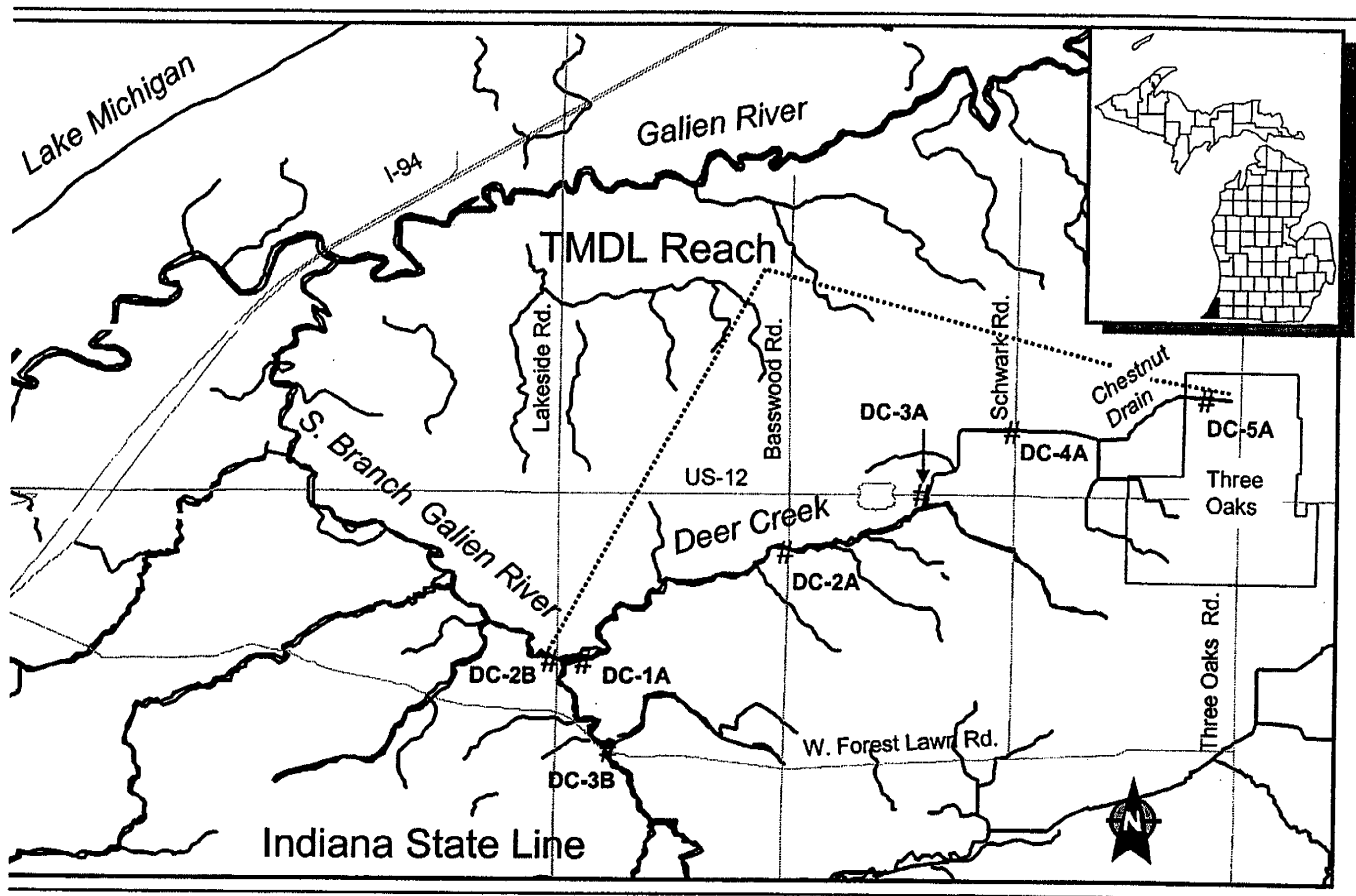


Figure 1. Deer Creek *E. coli* sampling locations, vicinity of Three Oaks, Michigan, 2001.

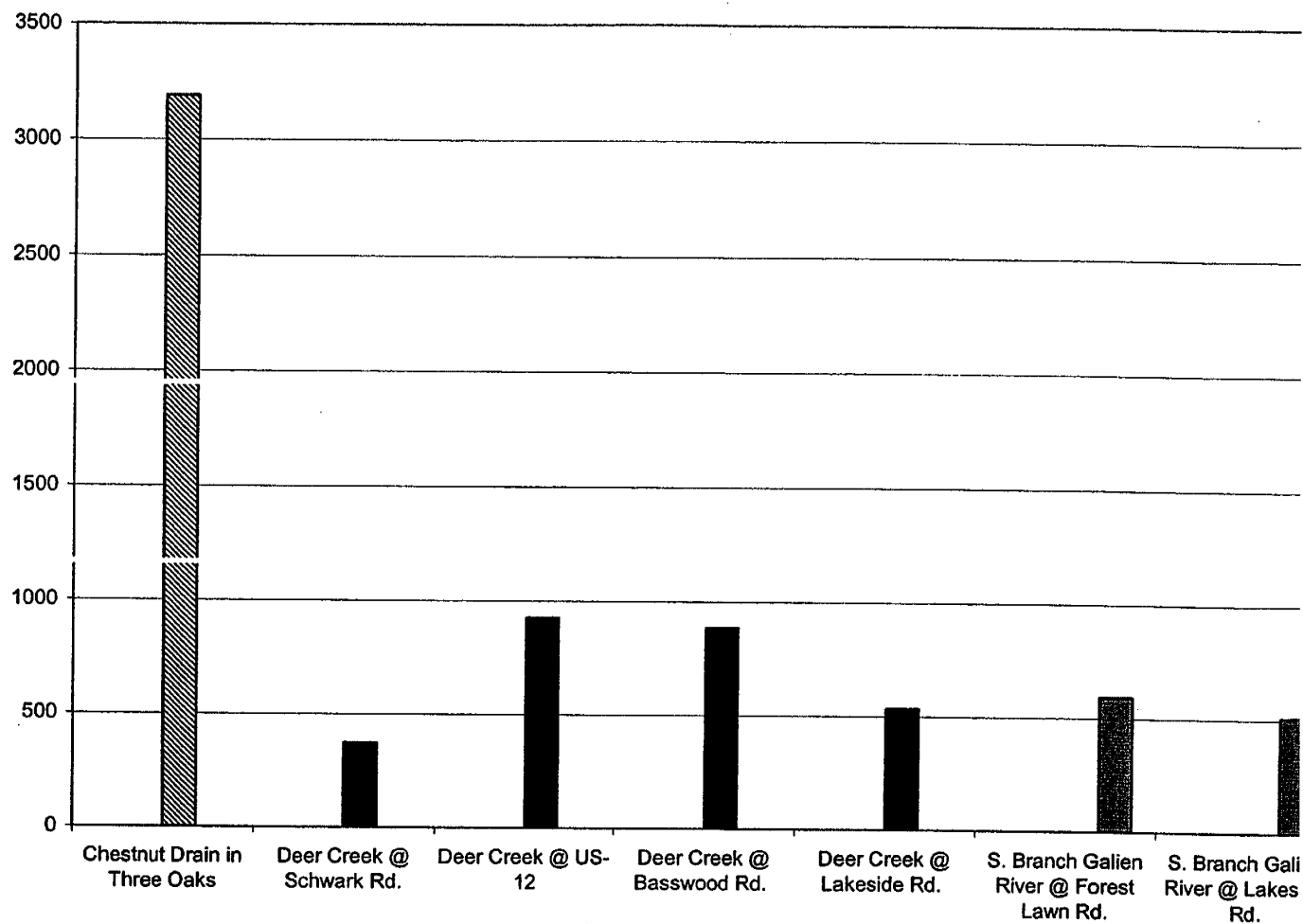
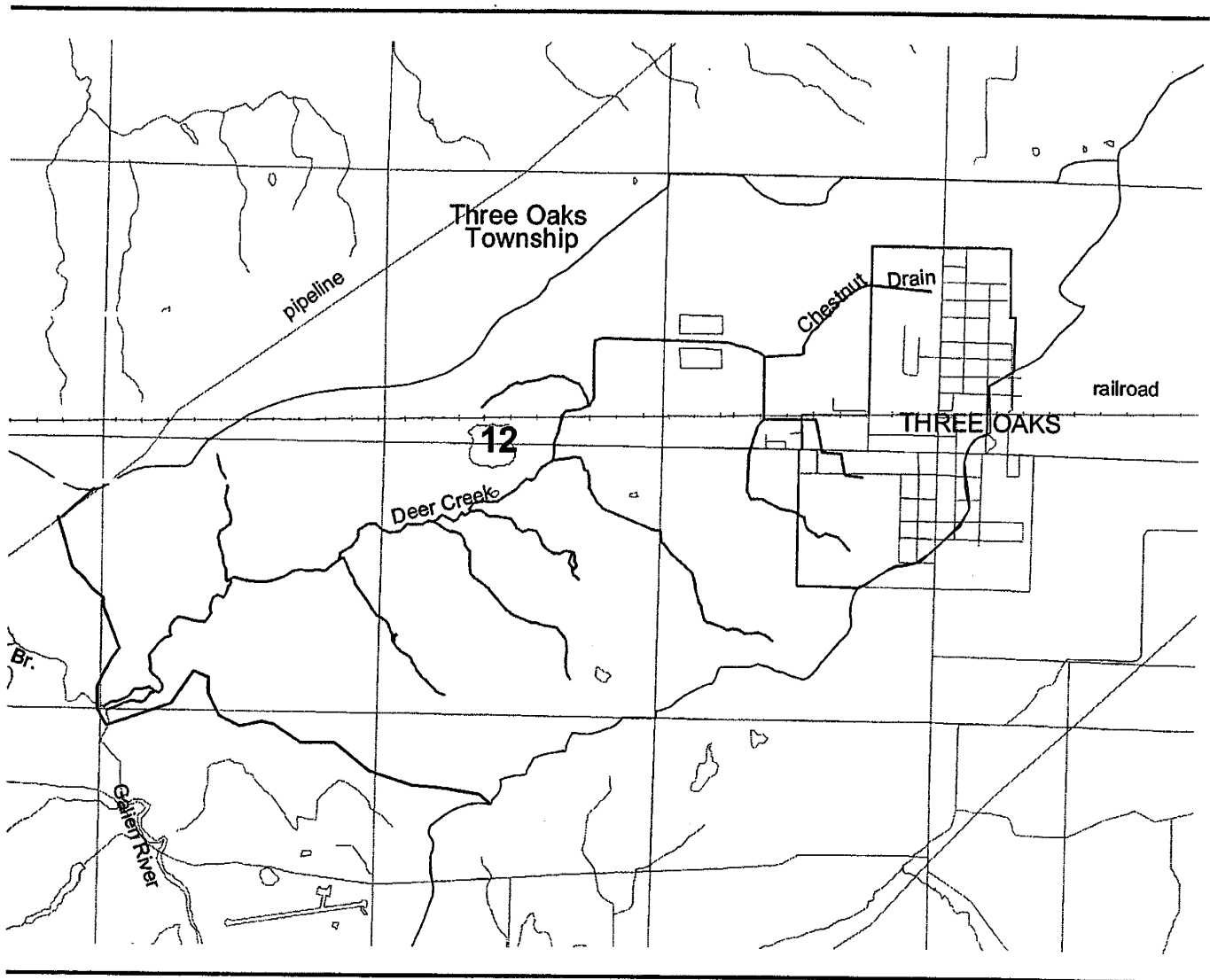


Figure 2. Geometric mean *E. coli* results from Deer Creek and related waterbodies, vicinity of Three Oaks, Three Oaks Township, Michigan, 2001.



re 3. The Deer Creek Watershed, including the Village of Three Oaks and Three Oaks Township.

ble 1. Deer Creek average flows (cfs) at the confluence of the South Branch Galien River.

<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>	<u>October</u>
5.3	3.8	2.6	2.3	2.2	2.5

Table 2. MDEQ *E. coli* data for Deer Creek and related waterbodies, vicinity of Three Oaks, Three Oaks Township, Michigan, 2001.

Sample Location	Month	<i>E. coli</i> concentration (#/100 ml)			# of results
		minimum	geometric mean	maximum	
Peanut Drain Three Oaks	May	3,600	5,794	7,400	3
	June	380	1,266	9,100	9
	July	1,370	4,491	8,200	9
	August	1,700	4,419	14,500	12
	September	2,200	2,735	3,100	3
Deer Creek @ Chwark Rd.	May	730	816	980	3
	June	60	245	830	12
	July	70	204	800	12
	August	320	828	4,900	12
	September	290	394	480	3
Deer Creek @ US-12	May	500	564	620	3
	June	890	1,188	1,700	6
	July	*	*	*	*
	August	*	*	*	*
	September	*	*	*	*
Deer Creek @ Lasswood Rd.	May	370	431	470	3
	June	850	1,273	1,900	6
	July	*	*	*	*
	August	*	*	*	*
		*	*	*	*
Deer Creek @ Lakeside Rd.	May	480	590	670	3
	June	400	743	1,900	12
	July	220	455	810	12
	August	120	679	4,500	15
	September	50	74	100	3
Branch Gallen River @ Forest Lawn Rd.	May	*	*	*	*
	June	290	507	760	6
	July	360	698	1,030	12
	August	310	620	1,100	15
	September	240	334	410	3
Branch Gallen River @ Lakeside Rd.	May	*	*	*	*
	June	200	266	340	6
	July	440	730	1,400	12
	August	70	499	1,070	15
	September	370	479	550	3

* no data collected during this month at this location.

Table 3. Distribution of land for each municipality in the Deer Creek Watershed.

Municipality	Watershed Area (sq. mi.)	Percent Land Area in Watershed
Three Oaks Township	4.35	87
Village of Three Oaks	0.65	13
TOTAL	5.0	100

Appendix 1. MDEQ 2001 *E. coli* monitoring data for Deer Creek and related waterbodies (*E. coli*/100 ml).
Data are presented upstream to downstream.

Chestnut Drain @ Three Oaks DC-5A	Deer Creek @ Schwark Rd. DC-4A	Deer Creek @ US-12 DC-3A	Deer Creek @ Basswood DC-2A	Weather data
5/29/2001	5/29/2001	5/29/2001	5/29/2001	Sunny, mild
3600	730	500	460	
7300	760	620	470	
7400	980	580	370	
6/6/2001	6/6/2001	6/6/2001	6/6/2001	Foggy, light drizzle
580	760	1100	1700	
900	830	1700	1700	
680	180	1000	1900	
6/13/2001	6/13/2001	6/13/2001	6/13/2001	Partly sunny, hot
annn	510	1240	940	
9100	380	890	850	
4200	520	1360	970	
6/20/2001	6/20/2001	6/20/2001	6/20/2001	Mostly cloudy, cool
380	90	not sampled	not sampled	
410	320	not sampled	not sampled	
440	330	not sampled	not sampled	
6/28/2001	6/28/2001	6/28/2001	6/28/2001	Sunny, hot and humid
SITE	100	not sampled	not sampled	
DRY	70	not sampled	not sampled	
	60	not sampled	not sampled	
7/5/2001	7/5/2001	7/5/2001	7/5/2001	Clear, sunny and mild
1370	800	not sampled	not sampled	
1820	660	not sampled	not sampled	
1820	700	not sampled	not sampled	
7/12/2001	7/12/2001	7/12/2001	7/12/2001	Mostly cloudy, mild
SITE	90	not sampled	not sampled	
DRY	90	not sampled	not sampled	
	70	not sampled	not sampled	
7/19/2001	7/19/2001	7/19/2001	7/19/2001	Hot and humid, light fog
8100	210	not sampled	not sampled	
8200	220	not sampled	not sampled	
8000	240	not sampled	not sampled	
7/26/2001	7/26/2001	7/26/2001	7/26/2001	Clear, sunny and mild
5800	130	not sampled	not sampled	
7700	110	not sampled	not sampled	
6900	160	not sampled	not sampled	
8/2/2001	8/2/2001	8/2/2001	8/2/2001	Overcast, hot and humid, light drizzle
9500	560	not sampled	not sampled	
9600	630	not sampled	not sampled	
14500	550	not sampled	not sampled	
8/9/2001	8/9/2001	8/9/2001	8/9/2001	Overcast, hot and humid
SITE	320	not sampled	not sampled	
DRY	330	not sampled	not sampled	
	350	not sampled	not sampled	
8/16/2001	8/16/2001	8/16/2001	8/16/2001	Heavy rain
8000	not sampled	not sampled	not sampled	
8000	not sampled	not sampled	not sampled	
8000	not sampled	not sampled	not sampled	
8/23/2001	8/23/2001	8/23/2001	8/23/2001	Overcast, mild, light fog
2700	4900	not sampled	not sampled	
2400	4900	not sampled	not sampled	
2400	3500	not sampled	not sampled	
8/29/2001	8/29/2001	8/29/2001	8/29/2001	Clear, sunny and cool
1720	610	not sampled	not sampled	
1700	550	not sampled	not sampled	
1800	510	not sampled	not sampled	
9/4/2001	9/4/2001	9/4/2001	9/4/2001	Mostly sunny, mild
3000	440	not sampled	not sampled	
3100	480	not sampled	not sampled	
2200	290	not sampled	not sampled	

pendix 1 continued. (*E. coli*/100 ml)

Deer Creek @ Lakeside Rd. DC-1A	S. Branch of the Gallen River @ Forest Lawn DC-3B	S. Branch of the Gallen River @ Lakeside Rd. DC-2B	Weather data
5/29/2001	5/29/2001	5/29/2001	Sunny, mild
480	not sampled	not sampled	
670	not sampled	not sampled	
640	not sampled	not sampled	
6/6/2001	6/6/2001	6/6/2001	Foggy, light drizzle
1040	not sampled	not sampled	
1100	not sampled	not sampled	
1900	not sampled	not sampled	
6/13/2001	6/13/2001	6/13/2001	Partly sunny, hot
720	not sampled	not sampled	
520	not sampled	not sampled	
1060	not sampled	not sampled	
6/20/2001	6/20/2001	6/20/2001	Mostly cloudy, cool
770	450	270	
730	290	300	
680	330	280	
6/28/2001	6/28/2001	6/28/2001	Sunny, hot and humid
400	720	200	
420	760	340	
500	720	230	
7/5/2001	7/5/2001	7/5/2001	Clear, sunny and mild
560	530	760	
600	790	610	
450	780	580	
7/12/2001	7/12/2001	7/12/2001	Mostly cloudy, mild
220	360	470	
230	530	500	
250	530	440	
7/19/2001	7/19/2001	7/19/2001	Hot and humid, light fog
810	900	610	
710	700	520	
800	900	1400	
7/26/2001	7/26/2001	7/26/2001	Clear, sunny and mild
420	730	1220	
370	930	1220	
570	1030	1240	
8/2/2001	8/2/2001	8/2/2001	Overcast, hot and humid, light drizzle
330	670	500	
320	550	430	
350	690	550	
8/9/2001	8/9/2001	8/9/2001	Overcast, hot and humid
180	610	600	
160	600	620	
120	1100	520	
8/16/2001	8/16/2001	8/16/2001	Heavy rain
2800	1000	970	
4300	700	1070	
4500	700	1000	
8/23/2001	8/23/2001	8/23/2001	Overcast, mild, light fog
1000	780	530	
2000	740	70	
2200	660	630	
8/29/2001	8/29/2001	8/29/2001	Clear, sunny and cool
450	330	430	
500	390	310	
440	310	400	
9/4/2001	9/4/2001	9/4/2001	Mostly sunny, mild
50	240	370	
100	380	550	
80	410	540	

Galien River Watershed
Debris

Site ID	Date	Water Color	Stream Flow	Stream Width	Stream Depth	Habitat	Buffer Width	Land Use Left	Land Use Right	Debris and Trash Description	Amount	Comments
252ABER0601	8-Oct-01	cloudy milk	stagnant	10' or less	<1'		>10'	woodland	woodland	appears that dirt has been dumped in the area debris covers holes	extensive	
22NBU3603	20-Aug-01	cloudy/milky	slow flow	11'-25'	1'-3'	t/s/h				Amounts of log jams from here back to last point.	extensive	
22NBU3602	20-Aug-01	cloudy/milky	slow flow	11'-25'	1'-3'	t/s/h				Log jams from this point back to last point about 1/4 mi.	extensive	
22NBU3601	20-Aug-01	cloudy/milky	slow flow	11'-25'	1'-3'	t/s/h				Log jams from this point back to last point and more ahead.	extensive	
22NBU3607	20-Aug-01	cloudy/milky	rapid flow	11'-25'	1'-3'	t/s/h				Log jams. River diverted around jams and erroded a new channel.	extensive	
22WEE0721	22-Aug-01	Very Muddy	slow flow	11'-25'	<1'	t/s/h			res	Huge tree fell in stream blocking it, river eroding bank behind roots	extensive	
460NBU3603	25-Sep-01	clear	slow flow	10' or less	<1'	herbaceous	>10'	res/com	res/com	see comments	extensive	
254BER0702	8-Oct-01	clear	rapid fl	10' or less	<1'		1'-3'	res/ com	agri	soil and debris covering most of the culvert	extensive	both sides, left side has severe log jams, conrete block, trees, veg. and 2' concrete culvert
22NBU0101	20-Aug-01	cloudy/milky	slow flow	25'-50'	1'-3'	t/s/h				Two log jams blocking80%channel. Log jams next 200' to300'	extensive	A couple of gullies in soy bean field on right hand side of bridge on down stream side.
4503GAL1101	8-Oct-01	clear	dry	10' or less	<1'		1'-3'	idle	res/com	Branches and dirt obstructing 1/2 of the culvert opening	moderate	
433THR2301	17-Sep-01	cloudy/milky	slow flow	10' or less	1'-3'	Trees			res.	Culvert 1' above water debris blocking flow and build up of sediment	moderate	
22NBU0209	20-Aug-01	cloudy/milky	slow flow	25'-50'	1'-3'	t/s/h			res/comm	Dead tree in channel down stream from wastewater treatment plant.	moderate	Many small white bubbles coming from treatment plant. Bubble forming a stream of 3 ft into river.
22NBU0205	20-Aug-01	cloudy/milky	slow flow	25'-50'	>3'	t/s/h				Dead tree in channel under the bridge.	moderate	
22NBU0304	20-Aug-01	cloudy/milky	slow flow	25'-50'	>3'	t/s/h		wetland	wetland	Dead tree in middle of river.	moderate	
22WEE0722	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	t/s/h				Dead trees in channel blocking river	moderate	
430THR1501	17-Sep-01	clear	rapid flow	10' or less	1'-3'	Trees		res.	res.	downed trees, both sides of bridge	moderate	tire, railroad tie, metal bracket, some limbs
22NBU0206	20-Aug-01	cloudy/milky	slow flow	25'-50'	>3'	t/s/h				Four log jams in this section of river.	moderate	
22WEE0723	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	t/s/h				Log jam blocking river, main log above water, another log jam u/s above water	moderate	
22NBU0202	20-Aug-01	cloudy/milky	slow flow	25'-50'	>3'	t/s/h		wetland	wetland	log jam in river block ing 50% of channel.	moderate	
22WEE0711	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22CHI1203	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0707	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0706	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0710	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0709	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0720	22-Aug-01	Very Muddy	slow flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22CHI1204	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22CHI1202	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0716	22-Aug-01	Very Muddy	rapid flow	11'-25'	1'-3'	Trees				log jam in river.	moderate	
22WEE0719	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0718	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0705	22-Aug-01	Very Muddy	rapid flow	11'-25'	>3'	Trees				log jam in river.	moderate	
22WEE0702	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0715	22-Aug-01	Very Muddy	rapid flow	11'-25'	1'-3'	Trees				log jam in river.	moderate	
22WEE0701	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0713	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0712	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22CHI1205	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0717	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22CHI1206	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0708	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0703	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	Trees				log jam in river.	moderate	
22WEE0704	22-Aug-01	Very Muddy	rapid flow	11'-25'	>3'	Trees				log jam in river.	moderate	
22NBU0207	20-Aug-01	cloudy/milky	slow flow	25'-50'	>3'	t/s/h				Log jams across from boat ramp.	moderate	
459WEE0702	28-Aug-01	cloudy	slow flow	11'-25'	1'-3'	Trees				log jams blocking the stream near the bridge 30' down stream from bridge.	moderate	
22NBU0102	20-Aug-01	cloudy/milky	slow flow	11'-25'	1'-3'	t/s/h				Log jams completely blocking river. Many log jams over next 500'-800'.	moderate	
22WEE0725	22-Aug-01	Very Muddy	rapid flow	11'-25'	<1'	t/s/h				Log jams in river about 200 feet downstream from bridge.	moderate	Logs caught up in the suspension on the underside of bridge.
22CHI1301	29-Aug-01		stagnant	25'-50'	1'-3'	Trees				Logs in the river.	moderate	
22NBU3605	20-Aug-01	cloudy/milky	slow flow	11'-25'	1'-3'	t/s/h				Lots of log jams at this site.	moderate	
22NBU0203	20-Aug-01	cloudy/milky	slow flow	25'-50'	>3'	t/s/h		etland	wetland	One tree has fallen into the water blocking 50% of channel.	moderate	Lots of run off from bridge/road.
412ANBU0203	24-Sep-01	clear	slow flow	10' or less	<1'			woodland	woodland	sediment	moderate	tile outlet on left bank obstructed by sediment
460NBU3601	25-Sep-01	clear	rapid flow	10' or less	<1'	herbaceous	>10'	woodland	res/com	see comments	moderate	debris collecting before a double culvert at rr
27WEE0303	24-Aug-01	clear	slow flow	10' or less	<1'	Trees	1'-3'	res.	res.	Several log jams in the stream up stream from Holden Rd. bridge.	moderate	
276WEE2101	23-Aug-01	cloudy	slow flow	10' or less	1'-3'	Trees	3'-10'	idle		Tires and snowmobile body in the stream, on the up stream side of bridge.	moderate	
4401THR0801	18-Sep-01	cloudy/milky	stagnant	10' or less	<1'		>10	woodland	woodland	tires, drained oil container	moderate	also some erosion. Pooling on other side of road.
22CHI2301	29-Aug-01	cloudy	slow flow	11'-25'	1'-3'	Trees	1'-3'	res.		Trees have fallen into river.	moderate	
22NBU0208	20-Aug-01	cloudy/milky	slow flow	11'-25'	>3'	t/s/h				Two more log jams on the left hand side of river about 100 feet apart.	moderate	Stream drops at least a foot to the surface of the stream. Culvert is too high.

Galien River Watershed
Debris

Site ID	Date	Water Color	Stream Flow	Stream Width	Stream Depth	Habitat	Buffer Width	Land Use Left	Land Use Right	Debris and Trash Description	Amount	Comments
4136NBU2401	24-Sep-01		stagnant	10' or less	<1'		1'-3'				moderate	
35NBU0101	24-Sep-01		rapid flow	11'-25'	>3'		>10'	woodland	woodland		moderate	flow slow due to wire in front of culvert. gully above culvert 1' deep, duck weed
459WEE0701	28-Aug-01	cloudy	slow flow	11'-25'	1'-3'	Trees				A couple of logs in the stream	slight	
263LAK2902	28-Aug-01	clear	slow flow	10' or less	<1'	Trees	3'-10'	res.	res.	Grass clipings in stream next to small tile outlet.	slight	
2751CHI1301A	29-Aug-01	clear	slow flow	10' or less	<1'	Trees				Island in stream with log jams around it & in the stream.	slight	Algae in pipe.
255BER0701	8-Oct-01	clear	slow flo	10' or less	<1'		>10'	woodland	woodland	some erosion	slight	
34WEE2102	23-Aug-01	cloudy	slow flow	10' or less	1'-3'	Trees	0		res.	Some log jams in the stream	slight	
276WEE2102	23-Aug-01	clear	slow flow	10' or less	<1'		>10'			Three tires in the stream where stream 276 meets 2761.	slight	

GALIEN RIVER
Crossings

Site ID	Date	Prec.	1st Rain	Water Color	Stream Flow	Stream Width	Stream Depth	Habitat	Buffer Width	Land Use Left	Land Use Right	Crossing Type	Crossing Material	Crossing Condition	Capacity	Surface	Erosion Location	Extent of Erosion	Comments
RDCHI2302	29-Aug-01	none	3 or more	none	dry	10' or less	don't know		1'-3'					poor	>1/4 full	paved	embankment	severe	Erosion above the culvert forming a hole in the ground. The hole is 2' long and 2' deep.
460NBU3602	25-Sep-01	light	1 or less	green	stagnant	10' or less	<1'			res/com	woodland		galvanized	fair	clean	paved	culvert outlet	severe	culvert 3' too high, pooling and causing erosion under culvert.
34BNBU1801	18-Sep-01	none	1 or less	clear	slow flow	10' or less	<1'	herbaceous	>10'	woodland	res/comm			fair	clean	paved	embankment	severe	gully off road, severe, gully min. on other side of bridge, may be a spring
225CHI2301	29-Aug-01	none	3 or more	rusty	slow flow	10' or less	<1'	Trees					plastic	fair	clean	unimproved	embankment	severe	Culvert 1' above str bed. Bank sparse veg & road runoff erosion 50' wide & 60' long. Clear/rusty water poss due to iron in gw
35ANBU0601	24-Sep-01	light	1 or less	cloudy/milky	stagnant	10' or less	<1'		>10'	woodland	woodland			fair	clean	paved	shoulder/ditch	severe	located at top of culvert
442THR3201	19-Sep-01	light	1 or less		stagnant	10' or less	don't know		>10'	woodland	woodland			good	clean	gravel	embankment	severe	both sides of road, potential for dirt sliding into creek, rocks placed end culvert & banks to help poss eros. Rd Comm put dirt on rd & banks, no rip rap
263LAK2904	28-Aug-01	none	3 or more	clear	stagnant	10' or less	1'-3'	Trees	0	roadside	idle		galvanized	good	clean	paved	embankment	severe	
RDCHI2801	30-Aug-01	none	3 or more	none	dry	10' or less	don't know	Trees					galvanized	poor	clean	paved	culvert outlet	severe	
34CTHR1701	18-Sep-01	none	1 or less	clear	slow flow	10' or less	<1'		>10'	woodland				poor	clean	paved	embankment	severe	left bank gully erosion 6' wide, 20' long, 2' deep
27BUC1801	24-Aug-01	none	1 or less	clear	slow flow	11'-25'	1'-3'	Trees						poor	clean	unimproved	embankment	severe	erosion on both sides of the road. Some work done to fix problem.
643WEE0201	24-Aug-01	none	1 or less	clear	slow flow	10' or less	<1'		3'-10'					poor	clean	paved	embankment	severe	
222CHI1301	29-Aug-01	none	3 or more	clear	stagnant	10' or less	<1'	Trees	0	res.				poor	clean	paved	embankment	severe	Stream obstructed by concrete blocks & culvert is 2' above stream bed. Ridght side of culvert has severe erosion caused by run off from road.
603BUC0801	27-Aug-01	none	2	clear	stagnant	10' or less	<1'	Trees					don't know	don't know	don't know	unimproved	embankment	severe	Erosion from road down to outflow and around culvert.
275CHI2401	29-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees				Bridge		good	obstructed	paved	embankment	severe	Stream partly obstructed by eros from rd. TOs 12" metal comes off br. Wahsout on rt of br, u/s side. washout 6' wide,4'deep, & 15' long. Eros left of br
413NBU1301	18-Sep-01	none	1 or less	clear	slow flow	10' or less	<1'		>10'	woodland	woodland			good	obstructed	gravel	embankment	severe	whole bank sliding in, road runoff, sediment in stream end of gully, erosion off road, problems both sides of road
441THR3201	19-Sep-01	light	1 or less		slow flow	10' or less	<1'		>10'	woodland	woodland			good	obstructed	gravel	embankment	severe	rocks obstruct flow, 200' embankment washing in towards creek both sides. Rd Comm put dirt on rd & banks, no rip rap for dirt, eros next to culvert
228CHI2201B	31-Aug-01	none	1 or less	clear	stagnant	10' or less	<1'	Trees					galvanized	good	obstructed	paved	shoulder/ditch	severe	
2710NBU3101	18-Sep-01	none	1 or less	none	dry	10' or less	<1'		>10'	woodland	woodland		galvanized	poor	obstructed	paved	culvert outlet	severe	culverts are too high, large amount of garbage in the way, near landfill
224CHI1201	29-Aug-01	none	3 or more	none	dry	10' or less	don't know	Trees	3'-10'	Browntown	res.		galvanized	poor	obstructed	paved	embankment	severe	End of culvert is crushed almost closed. Bad erodin 3ft from edge of road down & around culvet. Avg. width 2'-3', length 10'-15, & depth 1'-2.'
220CHI2701	31-Aug-01	none	1 or less		stagnant	10' or less	1'-3'	Trees					galvanized	poor	obstructed	unimproved	embankment	severe	Embankment eros both sides road, u/s ditch eros w/ embankment eros. D/s side culvert too high - eroded pool & bank across
412BNBU1101	25-Sep-01	light	1 or less	clear	stagnant	10' or less	<1'	herbaceous	>10'	res/com	res/com		galvanized	fair	clean	paved	shoulder/ditch	mod to severe	lot of sandy silt length of riverbed 1/4 mi N side. S side stag, 2' wide rdside eros, 1' w, 1' d 20' l. Tree debris u/s. Sand wash to fliplan (no veg) & creek
35ATHR1701	18-Sep-01	none	1 or less	clear	slow flow	10' or less	<1'		>10'	woodland	woodland			good	clean	paved	embankment	mod to severe	tube 18" above bed, some rocks underneath, gully 1-2' wide 1' deep 30' long, spring in hill
227CHI2201A	31-Aug-01	none	1 or less	cloudy	slow flow	10' or less	<1'	Trees						fair	>1/4 full	paved	embankment	moderate	
271THR0502	19-Sep-01	light	1 or less		stagnant	10' or less	<1'		>10'	woodland	wetland		galvanized	fair	clean	paved	embankment	moderate	road side gully erosion, some trees/limbs down in front of culvert, other side of road culvert too high scoring out and pooling.
4584BUC0701	24-Aug-01	none	1 or less	clear	stagnant	10' or less	<1'		0				galvanized	fair	clean	paved	embankment	moderate	erosion above & around culvert. Also on left streambank there is erosion and the bank is bare.
430THR2101	17-Sep-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees		res.	res.			good	clean	paved	culvert outlet	moderate	Bank is obstructing flow and diverting the water to the side of the culvert.
450GAL0402	1-Oct-01	none	3 or more	clear	slow flow	10' or less	1'-3'		>10'				galvanized	good	clean	paved	culvert outlet	moderate	layed cement at end of culvert causing fast flow down to water bed and digging bed, also lt side 6' bank is erosion
450GAL0301	1-Oct-01	none	3 or more	cloudy/milky	slow flow	11'-25'	<1'		1'-3'	res/com	res/com			good	clean	paved	embankment	moderate	eros both sides culvert, 6' bank, block & stone obstruction 20' from culvert downstream, no buffer at culvert, film on water, at Norris'Country Corner
RSCHI2901	30-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees					galvanized	good	clean	paved	embankment	moderate	Run off from road is running down the embankment & eroding two holes on top of the culvert.
275CHI2302	30-Aug-01	none	3 or more	cloudy	slow flow	11'-25'	1'-3'	Trees					galvanized	good	clean	paved	embankment	moderate	Embankment ob both sides of the road is eroding away. Bank is about 5' high.
2713THR3201	19-Sep-01	light	1 or less		stagnant	10' or less	<1'		No	res/com	woodland		galvanized	good	clean	paved	embankment	moderate	road runn off about 20', 1-3' wide, 1' deep, culvert too high causing pooling, no buffer mowed up to creek. frog and veg.
2201CHI2301	30-Aug-01	none	3 or more	cloudy	stagnant	11'-25'	1'-3'	Trees	<1'				galvanized	poor	clean	paved	culvert outlet	moderate	Culvert 3' above stream surface. Water from culvert eroded streambed forming deep pool below. Water stagnant
221CHI2801A	30-Aug-01	none	3 or more	clear	stagnant	10' or less	1'-3'	Trees		res.	res.		galvanized	poor	clean	paved	culvert outlet	moderate	Discharge from culvert has formed a pool below it.
458BUC0701	24-Aug-01	none	1 or less	cloudy	slow flow	11'-25'	1'-3'	Trees						poor	clean	unimproved	embankment	moderate	U/s gravel parking lot slopes to river-runoff & eros. D/s br. rt bank veg removed & replaced with dirt & stones
252BBER0101	8-Oct-01	none	3 or more	clear	slow flo	10' or less	<1'	herbaceous	<1'	agri	agri		galvanized	poor	clean	gravel	embankment	moderate	metal culvert flows into catchbasin and out an obstructed and broken clay tile outlet, pools water
RS2CHI2902	30-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees						poor	clean	paved	shoulder/ditch	moderate	Lenght of ditch & where it empties into stream there is erosion causing island in stream channel. Ditch is in section 30. Culvert is deteriorating
34WEE3601	23-Aug-01	none	1 or less	cloudy	slow flow	10' or less	1'-3'	Trees		res.		Single Culvert		poor	clean	paved	streambank	moderate	Stream drops at least a foot to the surface of the stream. Culvert is too high.
228CHI2201A	31-Aug-01	none	1 or less	clear	stagnant	10' or less	<1'	Trees					galvanized	good	obstructed	paved	embankment	moderate	Erosion down embankment caused by run off from road ditch has eroded a path down to stream. Also eroded dirt from behind culvert outlet.
RS2CHI2901	30-Aug-01	none	3 or more	clear	stagnant	10' or less	<1'	Trees						good	obstructed	paved	embankment	moderate	Eroded material from embankment has blocked the stream channel in front of the culvert.
221CHI2802	30-Aug-01	none	3 or more	none	dry	10' or less	don't know	Trees		res.	res.		galvanized	poor	obstructed	paved	culvert outlet	moderate	u/s of road, culvert blocked by logs. d/s culvert 1'-2' above stream surface, eroding pool in streambed.
271THR3201	18-Sep-01	none	1 or less	clear	slow flow	10' or less	1'-3'		>10'	woodland	woodland			poor	slow/wire	paved	embankment	moderate	Replace pipe & reallign. Suck hose, pipe rusted, head wall down front culvert. Eros on rd, dirt washes to creek, rd could cave in
4451CHI2701	30-Aug-01	none	3 or more	none	dry	10' or less	<1'	Trees	3'-10'		res.		galvanized	poor	>1/4 full	paved	embankment	minor	
265WEE0401	24-Aug-01	none	1 or less	clear	slow flow	10' or less	1'-3'	Shrubs	1'-3'	res.			galvanized	fair	clean	paved	culvert outlet	minor	culvert outlet 1 foot above water surface.
459WEE0703	28-Aug-01	none	3 or more	cloudy	slow flow	11'-25'	1'-3'	Trees						fair	clean	paved	embankment	minor	Very steep embankment with some erosion also run off from road.
450GAL0503	1-Oct-01	none	3 or more	clear	rapid flow	10' or less	1'-3'	herbaceous	3'-10'				galvanized	good	clean	paved	culvert outlet	minor	culvert 6" too high, digging, pooling, some minor erosion, 4-6' banks
2772THR1102	17-Sep-01	none	3 or more	cloudy/milky	slow flow	10' or less	1'-3'	Shrubs		res.	res.		galvanized	good	clean	paved	culvert outlet	minor	culvert too high, water green and stagnant
456BUC2001	24-Aug-01	none	1 or less	clear	slow flow	10' or less	<1'	Trees		res.			galvanized	good	clean	paved	embankment	minor	erosion or road run off above & down right side of culvert.
263LAK2901	28-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees	3'-10'	res.	res.			good	clean	paved	embankment	minor	On both sides of the road there is ersion on top of the culvert eroding behind concrete wall & to the left of culvert.
603BUC0901	27-Aug-01	none	2	clear	stagnant	10' or less	<1'	Trees					galvanized	good	clean	paved	embankment	minor	erosion from road down to stream next to culvert.
2775THR0101	10-Sep-01	none	1 or less	clear	stagnant	10' or less	<1'			rail road			galvinized	good	obstructed	paved	embankment	minor	Run off from the road causeing erosion of embankment
2412THR3601	10-Sep-01	none	1 or less	none	dry	10' or less	don't know	Trees					galvanized	good	obstructed	paved	embankment	minor	Upstream side has minor erosion caused by run off from road. Downstream side teh culvert outlet is obstructed by sediment.
34WEE2001	23-Aug-01	none	1 or less	clear	rapid flow	10' or less	<1'		>10'	agricultural	res.	Bridge		poor	obstructed	paved	streambank	minor	Lots of run off from bridge/road.
22NBU3606	20-Aug-01	none	1 or less	cloudy/milky	rapid flow	11'-25'	1'-3'	t/s/h				Bridge	Metal	good			left bank after bridge	minor	
22CHI1201	22-Aug-01	none	1 or less	Very Muddy	rapid flow	11'-25'	1'-3'	Trees				Bridge		good	clean	paved	none	none	Logs caught up in the suspension on the underside of bridge.
445CHI2701	30-Aug-01	none	3 or more	cloudy	stagnant	11'-25'	1'-3'	Trees	1'-3'				plastic	poor	clean	paved	none	none	Culvert is 1' above the water's surface. Discharge from culvert has eroded out the stream bottom making a pool. The stream no longer flows.
459LAK3101	28-Aug-01	none	3 or more	clear	stagnant	10' or less	<1'	Trees	3'-10'	res.	idle		galvanized	fair	obstructed	paved	none	none	tire blocking culvert and there is scum on the water surface.
227CHI2201B	31-Aug-01	none	1 or less	clear	slow flow	10' or less	<1'							fair	obstructed	paved	none	none	Culvet a big concrete box 5' high and about 3' wide. hole cut in bottom to let stream flow into box. Log blocking culvet outlet.
273BUC1801	27-Aug-01	none	2	clear	stagnant	10' or less	<1'						galvanized	fair	obstructed	unimproved	none	none	Culvert 90% blocked by mud.
458BUC0602	24-Aug-01	none	1 or less	cloudy	slow flow	11'-25'	<1'	Trees	>10'			double culvert	galvanized	good	obstructed	paved	none	none	
443CHI2801	30-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees	3'-10'				galvanized	good	obstructed	paved	none	none	Lots of logs in stream in front of culvert. Also on the other side of Rd. there is a white wooden fence across the stream.
458BUC0503	24-Aug-01	none	1 or less	clear	slow flow	10' or less	<1'	Trees	>10'				galvanized	good	obstructed	paved	none	none	Railroad tie & other objects blocking culvert.
34WEE2701	23-Aug-01	none	1 or less	cloudy	slow flow	10' or less	<1'	Trees	3'-10'			wooden pier	wood	good	obstructed	paved	none	none	
272WEE1301	24-Aug-01	none	2	clear	stagnant	10' or less	<1'		1'-3'				galvanized	poor	obstructed	unimproved	none	none	Culvert is mostly blocked by sediment
645BUC2101	27-Aug-01	none	2	clear	stagnant	10' or less	<1'	Trees					galvanized	poor	obstructed	unimproved	none	none	Water was clear, but amber in color. Culvert covered by mud & vegetation.
22NBU0204	20-Aug-01	none	1 or less	cloudy/milky	slow flow	25'-50'	>3'	t/s/h				Bridge	Concrete	good		paved	none	none	
2771THR1401	17-Sep-01	none	3 or more	green	stagnant	10' or less	1'-3'			Agriculture	Agriculture		galvanized	good	obstructed	paved			
2774THR0201	10-Sep-01	none	1 or less	cloudy/milky	stagnant	10' or less	<1'			rail road	Agriculture		other	poor	obstructed	gravel			Culvert broken

GALIEN RIVER
Rill Gullies

Site ID	Date	Prec.	1st Rain	Water Color	Stream Flow	Stream Width	Stream Depth	Habitat	Buffer Width	Land Use Left	Land Use Right	Rill & Gully Location	Rill & Gully Depth	Rill & Gully Width	Rill & Gully Length	Rill & Gully Height	Comments
2773THR1101	10-Sep-01	none	1 or less	clear	rapid flow	10' or less	<1'	Trees		res.	res.	right bank	4-5'	1-3'	15'	>6'	Vegetation covering erosion site
272WEE1301	24-Aug-01	none	2	clear	stagnant	10' or less	<1'		1'-3'			left bank	5'	3'	15'	>6'	Culvert is mostly blocked by sediment
412NBU1102	25-Sep-01	light	1 or less	clear	slow flow	10' or less	<1'		>10'	woodland	res/com		2'	1'	25'	<3'	more severe on left bank, road washing sand down to river. Culvert 3" too high 36"-42" galv culvert, severe
34BNBU1801	18-Sep-01	none	1 or less	clear	slow flow	10' or less	<1'	herbaceous	>10'	woodland	res/comm	left bank	1-3'	2'	25'		gully off road, severe, gully min. on other side of bridge, may be a spring
27WEE0402	24-Aug-01	none	1 or less	clear	slow flow	10' or less	<1'	Trees	1'-3'			left bank	2'	0.5'	3'	3'-6'	
34WEE2103	23-Aug-01	none	1 or less	cloudy	slow flow	10' or less	1'-3'	Trees	0		res.	right bank	3'	6"	3'	>6'	
36NBU1601	24-Sep-01	light	1 or less	clear	rapid flow	10' or less	<1'		>10'	res/com	res/com	right bank	2'	1'	4'	<3'	also debris and minor obstruction
25WEE3401	1-Oct-01	none	3 or more	clear	rapid flow	10' or less	<1'		>10'			right bank	1'	1'	6'	3'-6'	right along side of culvert are cement blocks and block wall, gully between blocks and wall, rd 3' from edge
4956CHI1201	29-Aug-01	none	3 or more	clear	stagnant	10' or less	<1'		0			right bank	2'	1'	6'	3'-6'	
4400THR0801	18-Sep-01	none	1 or less	N/A	dry	10' or less	don't know	herbaceous	>10'	woodland	woodland	left bank	2-3'	2'	6'	>6'	culvert 8" above bed, gully washing gravel in, veg on banks down stream
35ANBU0601	24-Sep-01	light	1 or less	cloudy/milky	stagnant	10' or less	<1'		>10'	woodland	woodland	left & right	2-3'	3-6'	6'	3'-6'	located at top of culvert
34WEE3401	23-Aug-01	none	1 or less	cloudy	slow flow	10' or less	<1'		0			right bank				>6'	A couple of gullies in soy bean field on right hand side of bridge on down stream side.

GALIEN RIVER
Livestock Access Sites

Site ID	Date	Prec.	1st Rrain	Water Color	Stream Flow	Stream Width	Stream Depth	Habitat	Buffer Width	Land Use Left	Land Use Right	Access Location	Access Length	Access Height	Cover	Comments
4511GAL1102	8-Oct-01	none	3 or more	muddy	stagnant	10' or less	<1'	grass				no banks	> 100'	<3'	stable vegetation	low open field cattle have complete access
4381THR1602	19-Sep-01	light	1 or less		slow flow	10' or less	<1'	bare	No			both banks	>100'	,3'	bare	beef cattle
4381THR1501	19-Sep-01	light	1 or less		stagnant	10' or less	<1'		No			right bank	>100'	>6'	sparse vegetation	cattle access some areas more severely eroded
27WEE1001	23-Aug-01	none	1 or less	clear	slow flow	25'-50'	1'-3'		0			both banks	>100'	3'-6'	sparse vegetation	
459WEE0601	28-Aug-01	none	3 or more	cloudy	slow flow	10' or less	<1'		0			both banks	10'-25'	3'-6'	sparse vegetation	cows in stream eroding bank. Picture taken here.

Site ID	Date	Prec.	1st Rain	Water Color	Stream Flow	Stream Width	Stream Depth	Habitat	Buffer Width	Land Use Left	Land Use Right	Stream Erosion Location	Erosion Length	Erosion Height	Severity	Extent	Comments
434GAL1801	1-Oct-01	none	3 or more	clear	rapid flow	10' or less	<1'	grass		res/com	res/com	right bank	<10'	3'-6'	mostly bare bank	entire bank	no buffer, res, wire fenced- looks like livestock could be living in the area.
2201CHI2302	30-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees	0	res.		both banks	>100'	50'	washout	entire bank	Banks severe eros for 300', very steep, 50' high. Grass clippings on left. Stream blocked by wood & concrete blocks. 3 metal 12" culverts
4406THR0901	18-Sep-01	none	1 or less	N/A	dry	10' or less	don't know	herbaceous	>10'	res/comm	woodland	right bank	10'-25'	3'-6'	mostly bare bank	entire bank	sediment carried to otherside of bridge causing sediment to build up
22NBU0201	20-Aug-01	none	1 or less	cloudy/milky	slow flow	25'-50'	>3'	grass/bare		woodland	res/comm	right bank before sea wall	10'-25'	>6'	Mostly Bare Bank w/ Rills	entire bank	
412NBU0201	24-Sep-01	light	1 or less	clear	slow flow	10' or less	<1'		>10'	woodland	res/comm	right bank	10'-25'	<3'	some bare bank	toe	could pose a problem if not fixed. Debris dumped
36NBU0102	24-Sep-01	light	1 or less	clear	slow flow	10' or less	<1'		>10'	woodland	woodland	both banks	10'-25'	3'-6'	washout	entire bank	
459WEE0704	28-Aug-01	none	3 or more	cloudy	slow flow	11'-25'	1'-3'	Trees				right bank	10'-25'	>6'	washout	entire bank	Located just after 1st bend in stream, about 100 feet downstream from saywer rd. bridge.
451GAL1201	8-Oct-01	none	3 or more	clear	stagnant	10' or less	<1'		>10'	woodland	woodland	both banks	26'-100'	>6'	bare bank with rills	entire bank	also some rill and gulley erosion, culvert too high
2710NBU3101	18-Sep-01	none	1 or less	none	dry	10' or less	<1'		>10'	woodland	woodland	both banks	26'-100'	>6'	washout	entire bank	culverts are too high, large amount of garbage in the way, near landfill
22WEE0714	22-Aug-01	light	1 or less	Very Muddy	rapid flow	11'-25'	<1'	Trees				left bank	6'	4'	minor	entire bank	
22NBU3606	20-Aug-01	none	1 or less	cloudy/milky	rapid flow	11'-25'	1'-3'	t/s/g				bridge at least 100' above river. Unable to see surface of bridge					
RDCHI2801	30-Aug-01	none	3 or more	none	dry	10' or less	don't know	Trees				Culvert discharge eroded hole below culvert 2'-3' deep. Tile under driveway eroding path to stream					
263LAK2904	28-Aug-01	none	3 or more	clear	stagnant	10' or less	1'-3'	Trees	0	roadside	idle	Severe erosion above culvert. Also 8"-12" PVC pipe tile outlet 1' above water eroding bank below					

Site ID	Date	Prec.	1st Rain	Water Color	Stream Flow	Stream Width	Stream Depth	Habitat	Buffer Width	Land Use Left	Land Use Right	Tile Outlet Location	Diameter	Outlet Material	Outlet Height	Outlet Flow Color	Outlet Flow Odor	Comments
4132NBU1802	24-Sep-01	light	1 or less	clear	stagnant	10' or less	<1'			res/com	woodland	left bank	2-12"&24"		6-12&12-36	none	none	
22NBU0210	20-Aug-01	none	1 or less	cloudy/milky	slow flow	25'-50'	1'-3'	Herb. & Grass	>10'		res/comm	right bank	12"	metal & concrete	>36"	clear	chemical/sewage	Many small white bubbles coming from discharge of treatment plant. Bubble forming a stream of 3 ft into river.
22CHI2301	29-Aug-01	none	3 or more	cloudy	slow flow	11'-25'	1'-3'	Trees	1'-3'	res.		left bank	12"		>36"	clear	none	sporatic flow out of pipe. Pipe is high up on stream bank, it has the possibility of causing serious erosion.
263LAK2903	28-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees	3'-10'	res.	res.	right bank	12"		0"-6"	clear	none	Bubbles in discharge from tile outlet, soap bubbles.
455WEE1301	23-Aug-01	none	1 or less	milky	stagnant	10' or less	<1'	Dead grass	0	res.	Road side	right bank	6"-12"		6"-12"	clear	none	
23WEE2901	23-Aug-01	none	1 or less	cloudy/milky	rapid flow	11'-25'	1'-3'	t/s/h	>10'	comm.	agricultural	left bank	6"-8"		>36"	clear	none	
22WEE0724	22-Aug-01	none	1 or less	Very Muddy	rapid flow	11'-25'	<1'	t/s/h		res		right bank	unknown	unknown	0"-6"	clear	none	
277THR1201	10-Sep-01	none	1 or less	clear	stagnant	10' or less	<1'	Shrubs		Agriculture	Agriculture	right bank	18"	clay	>36"	none	none	outlet needs to be extended to stream, severe erosion. 4' across 4-5' deep 10-15' long
22NBU3604	20-Aug-01	none	1 or less	cloudy/milky	rapid flow	11'-25'	1'-3'	t/s/h				left bank	4"	plastic	6"-12"	none	none	
454WEE0901	24-Aug-01	none	1 or less	clear	slow flow	10' or less	<1'		0	res.	res.	right bank	4"	plastic	12"-36"	none	none	minor erosion.
273WEE1701	23-Aug-01	none	1 or less	none	dry	10' or less	0			res.	res.	right bank	4"	plastic	6"-12"	none	none	Algae in pipe.
273WEE1701	23-Aug-01	none	1 or less	none	dry	10' or less	none	grass		res	res	right bank	4"	plastic	6"-12"	none	none	
2751CHI1301B	29-Aug-01	none	3 or more	clear	slow flow	10' or less	<1'	Trees				left bank	8"-12"		12"-36"	none	none	Tile runs from road near stream. Discharge eroding a channel to stream. Pipe needs to be extended to stream.
36NBU1601	24-Sep-01	light	1 or less	clear	rapid flow	10' or less	<1'		>10'	res/com	res/com		48"		6"-12"		none	also debris and minor obstruction
2772THR1102	17-Sep-01	none	3 or more	cloudy/milky	slow flow	10' or less	1'-3'	Shrubs		res.	res.				12"-36"			culvert too high, water green, cloudy & stagnant, poss. blocked further d/s

Initial Water Quality Statement Outline Prioritized Uses and Impairments

GALIEN RIVER WATERSHED

Designated and Desired Uses

IMPAIRED DESIGNATED USE	POLLUTANTS/ IMPAIRMENTS	SOURCES	CAUSES
#1 - Partial Body Contact Recreation (fishing, boating) minimum water quality standard E.coli - 1000 count/100 ml	#1 - E. coli (Water quality standard exceedances)	Livestock in streams ³	Unrestricted access
		Septic systems	Failing or poorly maintained
		Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
	#2 - Nutrients	Livestock in streams ³	Unrestricted access
		Septic systems	Failing or poorly maintained
		Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
		Agricultural sources ³	Poor tillage practices
			Over or misapplication of fertilizer/manure
			Lack of buffer and filter strips
	#3 - Obstructions	Cables strung across river	Landowners marking property
		Debris ³	Illegal dumping
		Road/stream crossings too small or blocked ³	Design of crossing and lack of erosion control measures on embankment
		Log jams ³	Streambank erosion
	#4 - Flow	Hydrology ¹	Altered stream banks and flow paths
			Sedimentation
			Increased imperviousness (s)
			Wetland destruction

GALIEN RIVER WATERSHED

Designated and Desired Uses

IMPAIRED DESIGNATED USE	POLLUTANTS/IMPAIRMENTS	SOURCES	CAUSES
#2 - Warm Water Fishery (Bass, pike, walleye) minimum water quality standard DO ≥7 ml/L	#1 - Sediment/Degraded habitat ²	Sheet flow	Lack of riparian buffer ³
		Cropland erosion ¹	Lack of riparian buffer
			Deforestation ¹
		Livestock in stream ³	Unrestricted access ³
	#2 - Nutrients ² (nuisance algal growths ⁷)	Streambank erosion ³	Groundwater seeps ⁵
		Livestock in streams ³	Unrestricted access ³
		Septic systems	Failing or poorly maintained
		Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
		Streambank erosion ³	Debris diverts flow path at banks
			Lack of buffers
		Agricultural sources ³	Poor tillage practices
			Over or misapplication of fertilizer/manure
			Lack of buffer and filter strips
	#3 - Flow	Hydrology ¹	Altered stream banks and flow paths
			Sedimentation
			Increased imperviousness (s)
			Wetland destruction
	#4 - Chemicals (s)	Orchard pest management	Over or misapplication of pesticides and chemicals ¹
#5 - Temperature	Reduced shade	Removal of riparian vegetation ³	
#3 - Cold Water Fishery (S. Branch - from Martin Road downstream to Forest Lawn, by landfill)	#1 - Temperature	Reduced shade	Removal of riparian vegetation ³
	#2 - Sediment	Sheet flow	Lack of riparian buffer
		Cropland erosion ¹	Lack of riparian buffer
			Deforestation
		Livestock in stream ³	Unrestricted access, animals disturb bank
	Streambank erosion ³	Groundwater seeps ⁵	
#4 - Other Indigenous Aquatic Life and Wildlife (habitat condition and continuity)	#1 - Degraded habitat	Forest fragmentation ¹	Rural residential development ¹
		Wetlands drainage ¹	Agricultural use ¹
			Residential development ¹
			Degraded quality of habitat ¹

GALIEN RIVER WATERSHED

Designated and Desired Uses

IMPAIRED DESIGNATED USE	POLLUTANTS/ IMPAIRMENTS	SOURCES	CAUSES
	#2 - Invasive/exotic species	Road Commission using fill from offsite ⁵	Lack of knowledge about dangers of invasive and non- native species
		Transfer through human activity (s)	Boat and bait buckets (s)
		Spread of species through watercourses	Extensive drainage system acts as conduit ¹
	#3 - Sediment ²	Sheet flow	Lack of riparian buffer
		Cropland erosion ¹	Lack of riparian buffer
			Deforestation ¹
		Livestock in stream ³	Unrestricted access ³
	#4 - Nutrients (nuisance algae and bacterial slime growth ⁷) Deer Creek	Streambank erosion ³	Groundwater seeps ⁵
		Livestock in streams ³	Unrestricted access ³
		Septic systems ⁷	Untreated sewage discharge
		Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
		Streambank erosion ³	Debris diverts flow path
			Lack of buffers
		Agricultural sources ³	Poor tillage practices
			Over or misapplication of fertilizer/manure
			Lack of buffer and filter strips
	#5 - Altered and high flow	Hydrology ¹	Altered stream banks and flow paths
			Sedimentation
			Increased imperviousness (s)
			Wetland destruction
	#6 - Chemicals (s)	Orchard pest management	Over or misapplication of pesticides and chemicals ¹
	#7 - Heavy metals	Storm water	Road and parking lot runoff drained to surface waters
			Wastewater plant cannot handle all storm water and alternative storm water management not

GALIEN RIVER WATERSHED

Designated and Desired Uses

IMPAIRED DESIGNATED USE	POLLUTANTS/ IMPAIRMENTS	SOURCES	CAUSES
#5 - Navigation (Partial reaches of Galien)	#1 - Obstructions ³		adequate
		Sewage	Improper disposal of hazardous household wastes
		Cables strung across river	Landowners marking property
		Debris	Illegal dumping
	#2 - Water levels	Road crossing too small or blocked	Design of crossing and lack of erosion control measures on embankment
		Log jams	Streambank erosion
		Hydrology ¹	Altered streambanks and flow paths ⁴
			Sedimentation ²
			Increased imperviousness (s) ⁶
			Wetland destruction ⁶
#6 - Agriculture (irrigation and livestock watering)	#1 - Bacteria	Development of riparian areas	Lack of riparian protection
		Livestock in streams ³	Unrestricted access
		Septic systems	Failing or poorly maintained
	#2 - Flow	Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
		Hydrology ¹	Altered stream banks and flow paths ⁴
			Sedimentation ^{2,4}
			Increased imperviousness (s) ⁶
			Wetland destruction ⁶
	#3 - Sediment ¹	Sheet flow ⁶	Lack of riparian buffer
		Cropland erosion ^{1,3}	Lack of riparian buffer ³
			Deforestation ¹
			Tillage practices
		Livestock in stream ³	Unrestricted access
	#4 - Flooding ¹	Streambank erosion ³	Groundwater seeps ⁵
		Loss of wetlands and floodplain function	Development
		Backing up of water and reduced flow ¹	Wetland drainage
			Log jams and debris ³
#7 - Total Body Contact	#1 - Bacteria	Livestock in streams ³	Unrestricted access ³

GALIEN RIVER WATERSHED

Designated and Desired Uses

IMPAIRED DESIGNATED USE	POLLUTANTS/IMPAIRMENTS	SOURCES	CAUSES
<p>Not historically a use in the Galien River itself (swimming at New Buffalo public beach between May 1 and October 1)</p> <p>Minimum water quality standard E.coli - 130 count/100 ml</p>		Septic systems	Failing or poorly maintained
		Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
	#2 - Nutrients	Livestock in streams ³	Unrestricted access
		Septic systems	Failing or poorly maintained
		Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
		Streambank erosion ³	Debris diverts flow path at banks
		Agricultural sources ³	Lack of buffers
			Poor tillage practices
			Over or misapplication of fertilizer/manure
			Lack of buffer and filter strips
	#3 - Petroleum products	Storm water	Road and parking lot runoff drained to surface waters
			Wastewater plant cannot handle all storm water and alternative storm water management not adequate
	#4 - Chemicals (s)	Orchard pest management	Over or misapplication of pesticides and chemicals ¹
#8 - Industrial Water Supply (potential future use)	#1 - Sediment	Sheet flow	Lack of riparian buffer ³
		Cropland erosion ¹	Lack of riparian buffer ³
			Deforestation ¹
		Livestock in stream ³	Unrestricted access ³
	#2 - Nutrients	Streambank erosion ³	Groundwater seeps ⁵
		Livestock in streams ³	Unrestricted access
		Septic systems	Failing or poorly maintained

GALIEN RIVER WATERSHED

Designated and Desired Uses

IMPAIRED DESIGNATED USE	POLLUTANTS/ IMPAIRMENTS	SOURCES	CAUSES
		Combined Sewer Overflows	Wastewater plant cannot handle all storm water and alternative storm water management not adequate
		Streambank erosion ³	Debris diverts flow path
			Lack of buffers
		Agricultural sources ³	Poor tillage practices
			Over or misapplication of fertilizer/manure
			Lack of buffer and filter strips
	#3 - Flow	Hydrology ¹	Altered stream banks and flow paths
			Sedimentation
			Increased imperviousness (s)
			Wetland destruction
	#4 - Chemicals (s)	Orchard pest management	Over or misapplication of pesticides and chemicals ¹

(s) = Suspected

1. Johnson, Cathy. 2001. Natural Resources and Conservation Directions. Berrien County, Michigan. Chikaming, Galien, Lake, New Buffalo, Three Oaks, and Weesaw Townships, Prepared for Chikaming Open Lands.
2. MDEQ Biological Surveys.
3. Inventory conducted by Ms. Anne Hendrix and Mr. Mike Mahler of the Office of the Berrien County Drain Commissioner, August-October 2001.
4. Quote of Spike Bruce in "Galien River Log Jam Clearing Begins" by Stan Maddux in the *South Bend Tribune*.
5. Observations during Galien Watershed Tour, October 2001.
6. Technical Team discussions.
7. MDEQ - SWQD, GLEAS, 303(d) list.